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Päivi Uljas

ENVIRONMENTAL MANAGEMENT ACCOUNTING (EMA) PRACTICES

A Case study of a Finnish manufacturing company

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UNIVERSITY OF VAASA
Faculty of Business Studies
Author: Päivi Uljas
Topic of the Thesis: Environmental management accounting (EMA) practices – A Case study of a Finnish manufacturing company
Name of the Supervisor: Annukka Jokipii
Degree: Master of Science in Economics and Business Administration
Department: Department of Accounting and Finance
Line: Master's Programme in Accounting and Auditing
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ABSTRACT

Interest in Environmental management accounting (EMA) has increased through the growing understanding of the relation between financial profitability and environmental factors. This research attempts to explore current EMA practices and describe EMA as a phenomen. More specifically, the intension is to investigate physical and monetary aspects of EMA, EMA tools and reporting and encountered challenges in EMA use.

EMA is often defined as integration of organizations' economic and environmental goals where both financial and non-financial information is utilized. The concept of EMA includes both physical material flows as well as monetary environmental information. EMA focuses on internal information to support decision-making, but also a two-way connection with external reporting has been identified, which refers that EMA may be used to construct external environmental reports or external environmental reporting may trigger a need for the development of EMA practices. This research is a mixed-method research with qualitative emphasis, but some quantitative aspects are included aswell. The research is conducted as a case study of one Finnish manufacturing company. Data is collected from multiple sources; semi-structured interviews, interviewer-administrated questionnaire and documentary analysis.

As a result for the case company, it was found out, that physical aspects of EMA are more emphasized over monetary aspects. It was aslo discovered, that Environmental Performance Indicators (EPIs) are the most used EMA method. Moreover, the most visible challenge in EMA use was identified as manual work, which increases the risk of human error and inconsistency in the figures. The general target of enriching the understanding of EMA and describing it as a phenomen, was achieved.

KEY WORDS: Environmental management accounting, EMA, Corporate Social Responsibility, eco-efficiency, case study

1 INTRODUCTION

1.1 Motivation to the study

Behaving in a socially responsible way is increasingly seen as essential to the long-term success of companies (Adams & Zutshi 2004: 31). Recently, the corporate social responsibility (CSR) reporting has increased and become a norm especially in larger companies (KPMG 2015). Reasons, which have led to this increase, are pressures from stakeholders and industry, competitive advantage and perceiving moral and ethical duty (Adams & Zutshi 2004: 33; Buhr, Gray & Milne 2014: 61). Simultaneously, the rise of voluntary external reporting may also have led to the to the development of practices to manage environmental issues, for example through environmental management accounting EMA.

While environmental Management system (EMS) is the taking account environmental aspects in strategic level, Environmental Management Control System (EMCS) is ensuring that the strategies become excecuted through different control methods. Furthermore, Environmental Management Accounting (EMA) is more operational level system, which focuses on measuring, techniques and accounting instruments in environment-related businesses. (Guenther, Endrikat & Guenther 2016: 6.)

Interest in environmental management accounting in companies has grown through the fact that environmental factors can have effect on the profitability and financial position of a business and it is expected that this effect further increase in future. (Bartolomeo & al. 2000: 35). Environmental accounting is a broad term, but for example Burritt et al. (2002: 41) have developed its classification to include two main groups of environmental impacts related to company activities. It divides environmental accounting to different orientation areas based on internal versus external dimension as well as monetary vs. physical dimension.

Even though EMA is focused particularly on *internal* information through monetary and physical environment-related accounting, Bouten and Hoozée (2013) have presented connection between external and internal aspects, which may work to both directions. They state that internal EMA information may be used to construct external environmental reports or external environmental reporting may trigger a need for the development of EMA practices. This finding has also inspired this research through an

assumption, that at least some environmental internal accounting methods are likely to be utilized in the companies, which include environmental matters voluntarily in their external reports, such as separate CSR report.

Prior research of EMA has mainly concentrated to normative arguments and praising the benefits of 'greening' of management accounting and there is only small, but growing, amount of academic research on EMA practices (Burritt 2004; Ferreira et al. 2010; Christ & Burritt 2013.) Therefore, it brings motivation to this research, in which the purpose is, particularly, to investigate the practical side of EMA and enrich the understanding of EMA as a phenomen. Moreover, the low-existence of literature related EMA use or applied methods, especially in Finnish context, have further motivated this study to explore EMA practices through in-depth analyses of Finnish manufacturing company.

This research attempts to increase understanding of EMA practices, including possible tools and instruments that are used, as well as reporting and analyzing. The research also tries to describe the encountered challenges in EMA practices and finally, it attempts to detect some future opportunities in the field of EMA and make some practical recommendations to the case company.

Conventional management and financial accounting have focused on helping managers to plan and control the corporate activities in order to gain maximimum profits of them, and the range of accounting techniques have constituted a communication path to inform the economic performance of a company to its stakeholders. Similarly, sustainability accounting has the potential to serve as a tool to help organizations to plan and control their social and environmental impacts. (Bebbington, Unerman & O'dwyer 2014.)

1.2 Research scope

The main purpose of this research is to explore the current EMA practices in the case company in a profound way in order to enrich the understanding of EMA as a phenomen. The focus of this research is *environmental*, where as social and economic aspects, which are commonly stated in relation to CSR, are excluded. Nevertheless, the background of CSR as a phenomen will be described in general terms, as environmental accounting and EMA are closely related to it. This research focuses on practical

dimensions of EMA including research questions that try to explore to what extent the case company identify environmentally related monetary costs and physical flows, which EMA tools are being used and how the existing EMA information is being analysed and reported. Yet the existing challenges and possible development paths are being described and discussed.

A consensus of EMA principles and contents has been reached where EMA tries to combine both financial (monetary) and physical information regarding environmental impacts of a company (Christ & Burritt 2013). EMA implementations can vary widely across countries and different types of organizations. EMA ranges from simple adjustments to existing accounting systems to more integrated EMA practices that link conventional physical and monetary information systems. (IFAC 2005.) One definition for EMA is stated by Bartolomeo et al. (2000: 37):

> *"the generation, analysis and use of financial and related non-financial information in order to integrate corporate environmental and economic policies, and build sustainable business"*

Several international bodies have given guidance and recommendations related to environmental management accounting. Schaltegger, Gibassier & Zvezdov (2013: 6) mentions that for example, International Federation of Accountants (IFAC) has been a major contributor of EMA through widely spread international guideline publication. These guidelines (IFAC 2005) have also been used as practical guide in this research. For example, many parts of definitions related to EMA and it's methods, physical and monetary aspects of it and other dimensios are based on these guidelines. When investigating EMA as a phenomen, answers to the following research questions are looked for

> *Q1) What physical environmental information (PEMA) the case company currently identifies and collects from its business operations?*
>
> *Q2) What monetary environmental information (MEMA) the case company currently identifies and collects from its business operations?*
>
> *Q3) Which EMA methods or tools have been implemented and how are they applied in a case company?*
>
> *Q4) How physical and monetary environmental information is being analyzed and reported?*
>
> *Q5) What challenges exists in EMA use and what kind of new opportunities can be identified in the field of EMA case company?*

In order to find the answers, the background and concept of EMA need to be explained and the concepts of physical and monetary environmental information need to be clarified. In addition, common EMA methods and tools found from literature shall be presented, in order to be able to reflect them to the ones possibly existing in the case company. The comprehensive framework of EMA will help to understand the different environmental information needs, which are the basis of analyzing and reporting EMA information. Moreover, the possible challenges encountered in EMA use will be seeked from earlier literature. The challenges of EMA use will be identified in order to turn them into opportunities and possible future EMA development.

1.3 Research methodology

This research has an essence of qualitative research, but some quantitative aspects are included aswell, and the research applies a case study strategy. The basis of qualitative research is to describe real life situations where attention is pointed in quality and meanings (Hirsjärvi, Remes & Sajavaara 1997: 161). Yin (2003: 15) also points out, that a case study strategy does not automatically imply qualitative research, but instead, case studies can be composed of both quantitative and qualitative evidence. Here, the intention is to use mixed-method research, where quantitative and qualitative data collection and analysis procedures are both used, but they are not combined (Saunders, Lewis & Thornhill 2007: 145–146).

Semi-structured interviews, interviewer-administered questionnaire and documentary analysis are data collection methods used in this research. Obtaining evidence from multiple sources is highly recommended when conducting a case study (Yin 2003: 14). Also know as “triangulation”, the use of many sources of data increases the realibility of the research, if the data is consistent (Saunders et al 2007: 139). Firstly, the external CSR reports that are published by the case company are examined and analysed. The intention is to get preconception of the environmental topics relevant to the case company by seeing, which topics are included in the external reporting.

In order to gather data to answer the first two research questions (Q1 and Q2) of what physical and monetary environmental information is being collected in the case company, the interviewer-administrated questionnaire part of the interviews was conducted in addition to the data observed in documentary analysis. The aim of using

questionnaire was to be able to categorize the data using basic statistical methods such as graphs. Simultaneously, the questionnaire enabled to get additional information to related topics.

Semi-structured interviews were designed to collect data of EMA methods (Q3), environmental information analyzing and reporting and (Q4) and encountered challenges in collecting and reporting environmental information (Q5). The goal was also to get support to the questionnaire part with additional information and clarifications. Total amount informants were 6, which included 3 face-to-face interviews with altogether 4 informants, 1 telephone interview and 1 exchange of e-mails. The interviews were transcribed to text form, with the total of 35 pages transcribed material.

Reliability measures how well other researcher would get the same results from the same research made all over again. In order to improve the reliability it is important to clearly state the research strategy and process that allows future researcher understand the decisions made. (Saunders et al. 2007: 317–320). That is especially important while conducting case study, as the documentation has been poor in case study history. Yin (2007: 38) suggests conducting the research as if someone were always looking over your shoulder. Here, the reliability will be improved by explaining step by step the data collection process and the rationale for decisions behind the research methods used.

Some limitations to the research and it's validity and generalizability forms the single-case study approach, where only one company was investigated. Generalizability of findings is not usually the intention in qualitative studies and case studies. However, the significance of the research may be increased by connecting the research to already existing theory and thus the study would test the applicability of the existing theory in a new context. (Saunders et al. 2007). It is admitted that broadening the scope to two or three orqanization would have improved the validility, but was impossible due to time restrictions.

1.4 Research structure

The study is structured in the following way: the next chapter presents earlier literature on corporate social responsibility and associated environmental themes, proceeding to the environmental accounting as a discipline. Chapter 3 proceeds to EMA more in detail covering the EMA definition, physical and monetary accounting and presenting comprehensive framework of EMA. Also examples of EMA practices and methods and tools are introduced. At the end of the chapter 3, benefits and challenges as well as EMA in Finland are discussed. Chapter 4 includes methodological choices for which this research is based and chapter 5 will present the key findings of the empirical part of the research. Chapter 6 presents the conclusions of the empirical findings and in last chapter 7 the outcomes of this research are discussed.

2 EARLIER LITTERATURE ON CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL ACCOUNTING

Corporate social responsibility is mainly concerned of environmental protection, the wellbeing of employees, the community and civil society in general, covering both present and future aspects. The concept of CSR includes underlying statement that corporations can no longer act only to pursue economical benefits but they need to take account broader society. Thus traditional views of competitiveness and profitability are no longer valid. (IISD 2013.)

The terminology used to cover corporate social responsibility matters is diverse, for example KPMG's Survey of corporate responsibility reporting (2013) mentioned "sustainability", "corporate social responsibility (CSR)", "corporate responsibility (CR)" and "sustainable development". In addition, during this study "social responsibility investment (SRI)" and "health, safety and environment (HSE)" have appeared in the academic literature. Hereinafter the term "Corporate Social Responsibility (CSR)" is being used in this study to describe the social, economical and environmental responsibility of an individual company.

2.1 Corporate social responsibility (CSR) reporting

Socially responsible business actions are seen essential in the long-term success of companies. Adams and Zutshi (2004: 33) reason that organizations may increase CSR reporting as a result of public pressure or changing legislation. Buhr, Gray and Milne (2014: 61) mention more rationales for CSR reporting, such as competitive advantage, industry pressure and moral and ethical duty. Moreover, Adams and Zutshi (2004) list several benefits that companies gain from taking responsibility of their social and environmental impacts, for example better recruitment and retention of employees, improved internal decision-making and cost-savings, improved corporate image and relations with stakeholders and improved financial returns.

Corporate social responsibility reporting has also increased over the years. (Adams & Zutshi 2004.) According to KPMG's (2015) corporate responsibility reporting survey the percentage of reporting companies in largest 100 firms in a country has increased steadily from 28 % in year 2002 up to 71 % in year 2013 and 73 % in year 2015. The

increase pace has slowed down, and large change is not expected unless driven by new mandatory regulations. On the other hand, KPMG (2015) reports the largest 250 companies in the world having reporting frequency of 92 %, which indicates that CSR reporting has become a norm in the larger companies. Buhr, Gray & Milne (2014: 57–58) also interpret the sustainability reporting trends so that despite the percentage of companies reporting has increased, the increase in verified reportings is more modest. For example, in Finland in year 2011, of 85 % of companies producing sustainability reports, only 29 % were verified. For year 2015, this information is not reported by countries, but in general the, 42 % of all reports were verified, which shows a modest increase from 38 % in year 2013.

It is important to note that good CSR reporting does not necessarily mean good performance. Good example is Shell Report, which won the first ACCA (The Association of Chartered Certified Accountants) Social Reporting Award in 2002. Through the winning report the company provided information for example on deaths at work, negative environmental impacts and problems in treatment of Ogoni people in Nigeria. This proves that the requirements of a good report are transparency, completeness and it should cover both negative and positive impacts on society and environment. (Adams & Zutshi 2004: 36.)

The Global Reporting Initiative (GRI) is a common international framework for voluntary reporting of social, economic and environmental impact in organization level. Its target is to improve comparability and credibility of CSR worldwide (IISD 2013). GRI4 reporting guidelines include reporting principles and internationally agreed disclosures and sustainability measures. GRI4 follows materiality principal, in other words, organizations may report only of the relevant topics for the organization or its stakeholders, which makes the report user-friendlier (Global Reporting Initiative 2013). One of its clear benefits, the GRI framework provides flexibility in CSR reporting, as there is different levels of compliance, where the company can position itself. In contrast, some of the pitfalls of GRI reporting are argued to be an inappropriate collection of especially the social and economic indicatiors as well as the non-existing requirement of the assurance of the reports. Furthermore, it is reasoned to be cautious about the voluntary reports, which have not been independently assured. (Buhr & al. 2014: 63–64.)

In comparison to GRI reports, which are considered as sustainable reports that may present organization's environmental impacts separately from its social or economic

impacts, the essence of “integrated report”, IR, is to present an unified, integrated picture of organization’s social, environmental, economic and governance performance and impacts. Integrated repors are governed and guided by International Integrated Reporting Council, IIRC. Their focus in the combined reports has been to target the information to providers of capital, rather than to a broader range of stakeholders. (Bebbington et al. 2014.) However, Buhr and al. (2014) concludes that IR reports shows strong signs to be significant factor in the future scheme of sustainability reporting.

2.2 CSR practices in Finland

New EU directive including new reporting obligations for large companies of environmental, social and employee related responsibilities will take effect from 2017 onwards. It obligates companies with over 500 employees, turnover at least 40 million euros or total assets at least 20 million euros to report current social, environmental and employee related practices and procedures as annual basis. The review can be either included as a part of the annual report by corporate government or published as a separate report. (Ministry of Employment and the Economy 2015.) According to Niskala, Pajunen and Tarna-Mani (2013: 219) if actualized, the new directive requires changes in current Finnish bookkeeping act.

Currently environmental matters in statutory accounting are outlined through a general guidance given by Finnish accounting association KILA in 2006. It states the principles of how to book and report environmental costs in accounting. It is important to note that this guidance defines costs as “environmental cost” only when the cost is generated of preventing, clearing or reducing the environmental effects of its business and shall be booked as yearly costs or as a balance sheet asset according to its nature. (Niskala et al. 2013: 223–225). Finnish government agreed on corporate responsibility resolution in 2012, which outlines basic principles of encouraging society and individual companies to act according to a socially responsible manner. It is targeted both to public and private sector companies and recommends for example improving disclosing non-financial environmental and social information of businesses as well as implementing management control systems that support building better corporate responsibility. (Ministry of Employment and the Economy 2012.)

Information of environmental matters is often collected for environmental permits, statistical purposes and for environmental management systems. Many companies

publish voluntary disclosures related to CSR matters instead of presenting them in the context of statutory balance sheet information. (Niskala et al. 2013: 221.) It is important to note, that the monetary information collected for national reporting purposes is typically narrower than the information needed for internal environmental decision-making. The existing data however, can help organizations to enlarge the data collection for EMA purposes. (IFAC 2005: 73.)

KPMG's (2013) survey of corporate responsibility reporting show, that 81 % of the largest 100 companies in Finland prepare and publish voluntary corporate responsibility reports. This is slightly above the global average of 71 % and Europe average of 73 %, but it is worth of notice that the reporting share in Finland has however decreased from 85 % in the preceding survey made in 2011. The most common voluntary CSR reporting standard is based on GRI guidelines. Currently the companies in Finland are reporting according to GRI 3 or newer version GRI4 is implemented in some companies (Ministry of Employment and the Economy 2015.)

Even though corporate social responsibility is important as a whole including environmental, economic and social responsibilities and in many companies they are controlled together (for example HSE department covers health, safety & environment), this research is concentrating and highlighting only the *environmental aspects* of corporate social responsibility.

2.3 Environmental management system (EMS) and environmental strategy

The ISO 14001 defines an environmental management system (EMS) as *"part of an organization's management system used to develop and implement its environmental policy and manage its environmental aspects"* (ISO 2004). EMS can also be considered as a sub system of the general management system that focuses on environmental issues (Guenther et al. 2016: 6.) This chapter presents the higher perspective of environmental management and proceeds to present environmental management control systems (EMCS) and 2.5 environmental information systems. Finally, chapter 2.6 focuses environmental accounting in more detailed level.

According to Guenther et al. (2016: 6), formulation of specific environmental goals, and the implementation of environmental processes and structures are essential parts of EMS. Some references also discuss the term "environmental strategy" (IMA 1995;

Epstein & Roy 2007), which is perceived to closely connect to be part of EMS. The wider and more strategic focus of EMS as well as the positioning compared to other environmental management systems are illustrated in Figure 1.

International Management Accountants' association IMA (1995) suggests three stages in developing the corporate environmental strategy in an organization: managing regulatory compliance (Stage 1), achieving competitive advantage (Stage 2) and completing environmental integration (Stage 3). In the first stage companies recognize the financial impacts of environmental matters and try to minimize the risks, such as litigation or cleanup costs. In the next stage companies realize that they can gain competitive advantage through more efficient resource use and they focus on cost avoidance in life cycle cost management. Finally, in stage three companies have fully integrated environmental components to day-to-day decision-making and they have recognized that long-term economic growth must be environmentally sustainable. They gain profits from antipollution efforts, operational efficiency as well as "green" products and services. Similarly, Epstein and Roy (2007: 394) mention certain elements of implementing an environmental strategy:

(1) setting environmental objectives and targets for facilities
(2) certifying a facility to an international environmental standard (e.g. ISO 14001)
(3) designing environmental programs
(4) allocating financial resources for environmental programs
(5) implementing systems to evaluate facilities' environmental performance.

2.4 Environmental Management Control System (EMCS) and Eco-Control

The difference with EMS and EMCS is quite clear and straightforward: where as EMS focuses on goals and processes, EMCS instead consists of various controls, such as cybernetic, cultural, or administrative controls to ensure that the environmental strategy is executed across the functions and divisions of the firm. It influences to employees' behaviors with intension to meet environmental goals and further contributes to strategy (re)formulation. (Guenther et al. 2016: 6.)

From environmental strategy elements presented earlier, especially the last (5), covering environmental performance evaluation is the area where environmental management control systems (EMCS) are introduced. Pondeville, Swaen and De Ronge (2013: 318)

clarify the concept of EMCS to include formal, information-based routines and procedures that are used for managing environmental aspects of organizational performance. This may include ensuring that environmental staff participates in capital budgeting process or that environmental criteria are integrated in the investment decision-making. Also inclusion of environmental performance indicators to reward systems and comparison of environmental goals versus results are features of formal EMCS. Prior literature also recommends using informal control systems, such as employees' participation, managers' involvement and teamwork, to solve and manage environmental problems.

Pondeville et al. (2013) conclude their study of contextual and strategic factors effecting EMCS development in manufacturing companies, that in some companies high level of perceived ecological environmental uncertainty (PEEU) encourages the managers to gather more information of the uncertain environment and thus creating EMCS. In some companies the effect is contradictive: companies take wait-and-see position, where high level of PEEU is a brake for developing EMCS. The research also concluded that especially organizational stakeholders create pressure for environmental issues and may lead to development of EMCS. It is also emphasized that employees' and managers' support and involvement are essential to a company that reaches towards proactive environmental strategy.

Furthermore, another term "eco-control" can also be associated to EMCS (Guenther et al. 2016). Henri & Journeault (2010: 64) state that eco-control is the application of financial and strategic control methods to environmental management and is designed to help organizations to measure, control and disclose their environmental performance. They define eco-control as "the formalized procedures and systems that use financial and ecological information to maintain or alter patterns in environmental activity".

Eco-control includes environmental matters in addition to conventional management accounting information that is available in management control system (MCS). Eco-control is used to quantify the environmental actions of an organization and build organizational routines that take account environmental aspect. Henri and Journeault (2010: 64) composed eco-control of three important practices: uses of performance measures, budgeting and incentives. Applying eco-control allows managers to get frequent feedback information to compare environmental goals and outputs. It helps managers to strive towards the goals and promote and communicate strategic priorities. Furthermore, eco-control directs managers to critical areas of concerns and eventually

eco-control may lead to continuous improvements in environmental matters. (Henri & Journeault 2010.)

Henri and Journeault (2010) investigated to what extent eco-control influences environmental and economic performance, but their study failed to prove that eco-control has direct effect on economic performance. Instead, they succeeded to show environmental performance to have an indirect influence in economic performance in certain contexts: if a company has higher exposure to future environmental costs, higher public visibility, higher environmental concern (company's devotion to environmental practices) or the company is larger at size. Overall their study implicated that managers should be aware of the importance of integrating environmental matters into the existing management control system in order to increase environmental and economic performance.

While eco-control can be seen as a synonym for EMCS, and EMCS has clear distinction to broader concept of EMS, it is more complicated to position EMA in the field of environmental management. Guenther et al. (2016: 4) divides the concepts of EMA and EMCS as illustrated in Figure 1 below: While EMA refers to tools, techniques and instruments that support managerial decision-making, EMCS go beyond information delivery and decision support through influencing environmental routines and processes to adjust them to corporate strategy. Still they admit that EMCS utilize EMA and there is partial overlap between the two concepts.

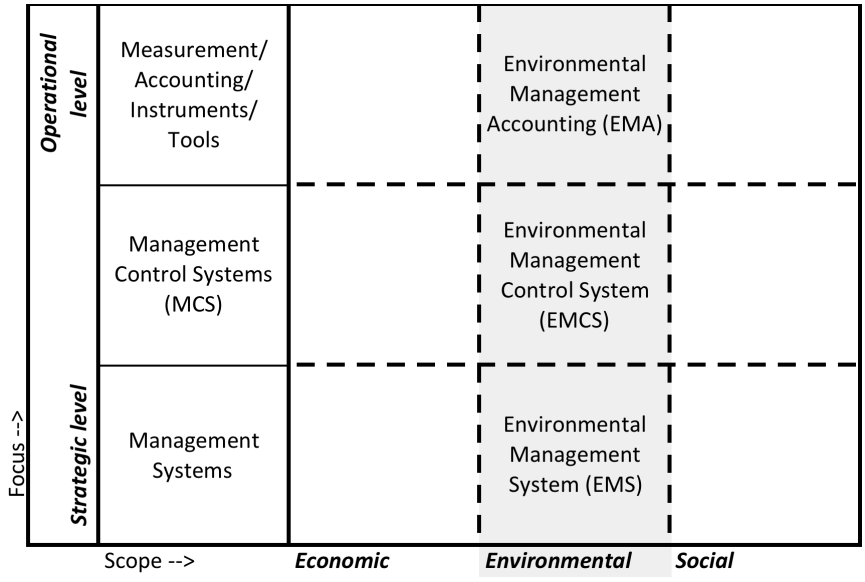

Figure 1. Positioning framework for environmental systems (modified from Guenther et al. 2016).

2.5 Environmental information systems

Pondeville et al. (2013: 319) define an environmental information system to a system implemented to provide useful environmental information to managers, with the purpose of complementing other existing systems. Environmentally proactive companies collect, besides internal data, also external data such as predictions about future environmental legislation and consumers' preferences for "green" products. They found out that the use of environmental information system was positively associated with the development of EMCS.

Environmental information can be set up in separate Environmental Management Information System (EMIS) or in the existing IT infrastructure. The integrated way may be beneficial for several reasons; increased information quality, improved measures for strategy implementation and higher transparency within the company. The integrated environmental information system can provide information to the employees who need it and help decision-making in all levels. (Lang, Heubach & Loew 2005: 150.)

Even though environmental information systems would be interesting part of environmental management accounting to be explored, the topic is mentioned only to note its existence and otherwise excluded from following chapters and empirical research.

2.6 Environmental accounting

Environmental accounting has been used as a common term in the early literature issued by United States Environmental Protection Agency (USEPA) to indicate companies' environmental responsibility through accounting. Since then, environmental accounting has continued to focus on financial accounting and dealt with the institutionalizing environmental concerns, disclosure practices, financial performance and assurance procedures. During the past decade, the stream of environmental management accounting (EMA) grew up into an independent area of study focusing to support organizations to adopt environmentally conscious decision making practices. (Debnath, Bose & Dhalla 2012.)

As environmental accounting is a broad term, Bartolomeo, Bennet, Bouma, Heydkamp, James & Wolters (2000: 32–36) have classified it more in detailed. They identified four company level approaches to environmental accounting, based on the information target group (external vs. internal) and whether the type of data is financial or non-financial data. Each approach represents some orientation of environmental accounting. Financial reporting has external target groups, such as customers, investors and other stakeholders, who are interested in information especially of environment-driven financial risks. Similarly, social accountability reporting concentrates on external stakeholders in general, but the target group is a society as a whole.

Energy and materials accounting includes especially monitoring of physical flows of fuels, materials, water, gases etc. and the data is used for internal life-cycle assessment (LCA). On contrary, environmental management accounting includes internal environmental factors that can affect on company's profitability, for example high and increasing levels of capital and operating expenses for pollution control equipment, additional costs incurred due to public concern over environmental issues and new "eco-taxes". The main focus of this study is the approaches supporting internal decisions, more specifically, energy and materials accounting and environmental manatement accounting. (Bartolomeo et al. 2000: 32–36.)

Burritt et al. (2002: 41) have developed the classification even further into a broader concept of environmental accounting including two main groups of environmental impacts related to company activities. First, *environmentally related impacts on the economic situation of companies* are impacts measured through monetary environmental information typically based on conventional accounting, for example measures of expenditure on cleaner production, cost of fines for breaching environmental laws or monetary values of environmental assets. Secondly, *company-related impacts on environmental systems* are impacts to natural environment caused by corporate actions. These impacts are viewed through physical environmental information and are expressed in physical units, for example kilograms of material per customer served, joules of energy used per unit of product.

Figure 2 presents the Burritt et al.'s (2002: 41) classification of environmental accounting, which also takes account monetary vs. non-monetary views besides internal vs. external view. The concept of environmental management accounting (EMA) is broader than in the previously presented classification by Bartolomeo et al. (2000) and consists of both monetary and physical information for internal purposes. The terms

MEMA and PEMA are introduced in their model, which refer to monetary/physical environmental management accounting. Also, external environmental accounting is divided to monetary (MEEA) and physical (PEEA) emphasis on reporting, which together are referred with term "external environmental accounting". As delineated earlier, this study will focus on the upper side of the Figure 2 including the internal side of environmental accounting, namely EMA.

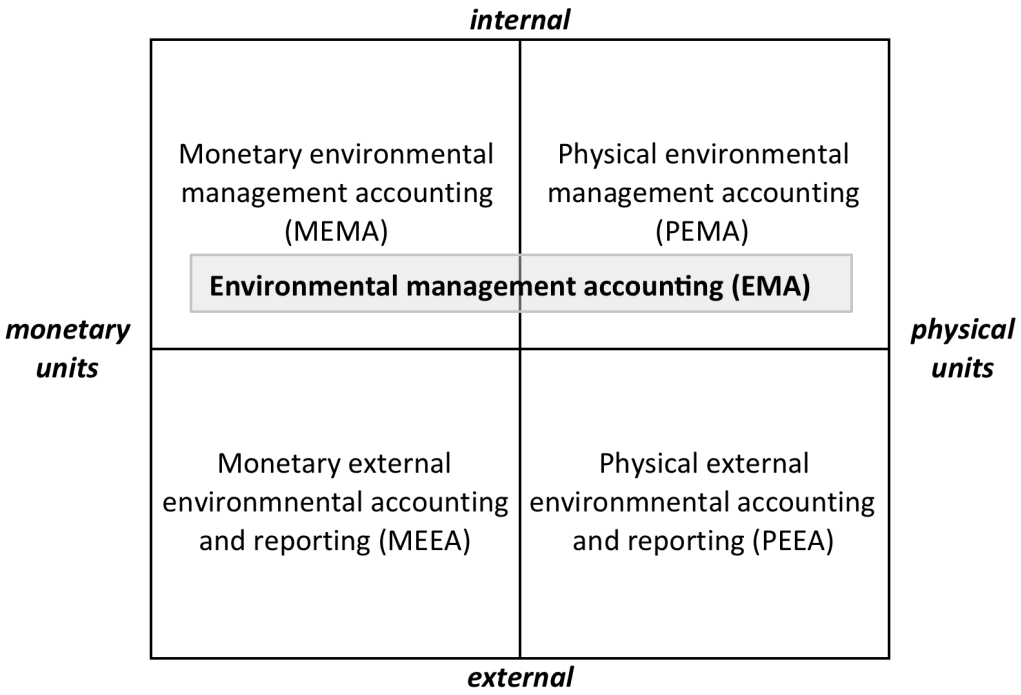

Figure 2. Environmental accounting systems (modified from Burritt et al. 2002: 41).

Frost & Seamer (2002) found evidence that more developed environmental management practices led to a higher level of environmental disclosure in annual reports, but on the other hand, the relation to environmental accounting was not supported as strongly. Bouten & Hoozée (2013) tried to investigate the interplay between environmental reporting and EMA in organizational change process as it had been noted in earlier literature that external and internal accounting practices might be related. Their conclusion in the case study of four companies over a two-year period was, that interplay might arise in both directions; EMA information may be used to construct external environmental reports or environmental reporting may trigger a need for the development of EMA practices (Bouten & Hoozée 2013).

Obviously, the external environmental reporting is important part of companies' environmental activities, as the debate on environmental issues increases among stakeholders. Also, the new reporting requirements especially for large companies are likely to accelerate the importance of external reporting. The increased existence of external corporate CSR reports also leads to an assumption, which has inspired this study: at least some environmental internal accounting methods are likely to be utilized in the companies reporting environmental matters as a part of CSR report. Next chapter will introduce internal management accounting EMA, the main focus in this study, more in depth.

3 ENVIRONMENTAL MANAGEMENT ACCOUNTING (EMA)

Interest in environmental management accounting in companies has grown through the fact that environmental factors can have effect on the profitability and financial position of a business and it is expected that this effect further increase in future. One definition for EMA is stated by Bartolomeo et al. (2000: 37):

> *"the generation, analysis and use of financial and related non-financial information in order to integrate corporate environmental and economic policies, and build sustainable business"*

International Federation of Accountants (IFAC) defines EMA in Managing Accounting Concepts (IFAC 2005: 19) as

> *"the management of environmental and economic performance through the development and the implementation of appropriate environment-related accounting systems and practices. While this may include reporting and auditing in some companies, environmental management accounting typically involves life-cycle costing, full-cost accounting, benefits assessment, and strategic planning for environmental management."*

While there are many differing definitions of "EMA", there has recently become consensus that EMA seeks to combine both financial and physical information regarding the environmental impacts and performance of a business (Christ & Burritt 2013: 164). While EMA is generally included in organizations' management accounting and internal information, it may also have links between organizations' financial accounting, more specifically with the external environment-related information reporting. As the requirements for environmental reporting increase, organizations can use the same information originally collected for internal EMA purposes to fulfill their external reporting requirements. EMA implementations can vary widely across countries and different types of organizations. EMA ranges from simple adjustments to existing accounting systems to more integrated EMA practices that link conventional physical and monetary information systems. (IFAC 2005.)

Increasing pressure from stakeholders has created the need for new techniques to assist managers to control environmental issues. Environmental management accounting EMA is a method, which covers a number of tools for recognizing and managing environmental impacts that conventional management accounting have failed to

response. (Christ & Burrit 2013: 163). However, accounting as an internal information system is well suited for collecting information for evaluating and controlling the environmental system. Some information may already exist, but most of it will not be systematically collected. Therefore, some readjustment may be applicable and in that process management and financial accounting can be helpful in identifying material flows and to associate costs to them. (Masanet-Llodra 2006: 395.)

This chapter 3 first presents EMA as the discipline and the physical and monetary aspects of EMA more in detailed, continues to overview some EMA methods and proceeds towards comprehensive framework for EMA. After the theoretical framework some EMA practices found from literature review are presented. Finally, benefits and challenges are discussed as well as the EMA practices in Finnish context.

3.1 EMA as a discipline

Several international bodies have given guidance and recommendations related to environmental management accounting. Schaltegger, Gibassier & Zvezdov (2013: 6) implies that major impact on common understanding of EMA has been done by United Nations Division of Sustainable Development (UNDSD), which has invested considerable resources of experts and stakeholders in order to increase and share knowledge in the field. They also acknowledge International Federation of Accountants (IFAC) as a major contributor of EMA through widely spread international guideline publication. They mention that EMA has become increasingly popular topic for other international organizations as well, namely Association of Chartered Accounts (ACCA), the Institute of Chartered Chartered Accountants of England and Wales (ICAEW) and Canadian Institute of Chartered Accountants (CICA). In addition, International Organization for Standardization (ISO) has developed normative documents, a whole ISO 14000 family of Environmental Management, to encourage environmental matters to be adapted in product design. Some EMA aspects are also included in the standards, specifically Life Cycle Assessment in ISO14040 (ISO 2006). Masanet-Llodra (2006) states that regardless of which standard or guideline is being referred, it is essential to collect information for evaluating and controlling the system.

Schaltegger et al. (2013) explored whether EMA is a discipline through bibliometric literature review, including journal papers, books and other professional literature. Their study revealed that the growth rate of EMA publications since 1990 has increased rapidly but substantial part of the publications has been published outside the

mainstream accounting journals in non-accounting journals, books and reports. The geographical focus is in Europe, especially in UK and Germany and also in Australia, whereas USA is underrepresented. The overall results indicate that EMA has become an acknowledged accounting discipline. Nevertheless, as EMA is still a young discipline, where the area is developing rapidly and increasing range of authors and regions are involved, its further expansion in the future is expected.

3.2 Physical EMA information

EMA focuses usually on such physical information measures as materials and materials-driven costs because use of energy, water and materials as well as the generation of waste and emissions are directly related to organizations' environmental effects and because materials purchase costs are a major driver in many organizations. For example in a manufacturing company, purchased material is converted into final product, which is delivered to customers. Manufacturing operations spend materials that are needed for the manufacturing process but are not included to the final product, thus they create waste streams that must be managed. Secondly organizations must take account the environmental impact of the final product that leaves to customer. Overall the product manufacturing has high environmental impacts and correspondingly benefits of product improvements would be high. This leads to a need for accurate data on the amounts of all the energy, water and materials used for the whole manufacturing process (IFAC 2005: 30–36).

When using EMA physical accounting, organizations should try to track all physical flows and ensure that significant amounts of energy, water or other materials are accounted for. This accounting may be called "materials balance", "input-output balance", "mass balance" or an "eco-balance". The underlying assumption is that all physical inputs must eventually become outputs – either physical products or waste and emissions – and the inputs and outputs must balance. (IFAC 2005: 30–36.) Input-output balance is illustrated in the left side columns in Figure 3. Different types of physical materials inputs are raw and auxiliary materials, packaging materials, merchandise, operating materials, water and energy. According to same classification, outputs are either product outputs (products or by-products including packaging) or non-product outputs (NPOs) such as solid waste, hazardous waste, wastewater and air emissions.

Environmental data can be collected through absolute indicators (e.g. the total amount of water consumed) or through relative indicators (e.g. amount of water consumed per unit produced). These relative indicators often combine physical and monetary information used under EMA. (IFAC 2005: 30–36.)

Burritt et al. (2002: 41) divides the concept of EMA to monetary and physical aspects as seen in Figure 2. Physical Environmental Management Accounting (PEMA) produces information for internal purpose focusing on a company's impact on natural environment. It serves for example as analytical tool for detecting ecological strengths and weaknesses, a measurement tool for company performance, a tool for direct and indirect control of environmental consequences and a base for neutral and transparent internal and external communication. (Burritt et al. 2002: 41.)

In this research, where the aim is to build understanding to EMA practices in a Finnish company, the first research question is

> Q1) What *physical* environmental information (PEMA) the case company currently identifies and collects from its business operations?

3.3 Monetary EMA information

Monetary Environmental Management Accounting (MEMA) generates information for internal management use providing basis for operational planning and decision-making. It provides information of costs and revenues that are incurred because of the company's impact on environment, for example costs of fines for breaking environmental laws and investment in capital projects that improve the environment. It is usually based on conventional management accounting, which is extended to cover environmental aspects of company activities. MEMA is the central tool to provide information to support most internal management decisions as well as the monitoring tool of costs and revenues that are environmentally related. (Burritt et al. 2002: 41.)

National regulation usually covers only environmental protection expenditures (EPEs) when discussing environmental costs. EMA includes also other important monetary information that is needed to steer cost-effectively environmental performance. However, majority of EMA implementations do not typically include "external" costs

that cover environment-related costs incurred by individuals, business partners, society or the planet for which organizations are not legally responsible. (IFAC 2005: 22).

Monetary data can be collected for an organization as a whole or for smaller entities, input materials or production lines, depending on the organization's interests. Even though physical and monetary sides of EMA are presented separately, it is important to link all physical measures with appropriate cost categories for consistent and accurate EMA. Monetary information can also be combined with physical data in order to create environmental performance indicators (EPIs) or eco-efficiency indicators. (IFAC 2005: 37).

Cost categories in use vary among organizations, but some general categories are presented by IFAC (2005: 38) and are illustrated in the right side column in Figure 3: (1) Materials costs of product outputs and (2) Materials costs of non-product outputs (NPOs) are the most relevant cost categories at least in manufacturing business. The first includes the purchase costs of materials inputs that are converted into products, by-products and packaging. The cost information of materials helps organization to manage the materials-related environmental impacts of its products. The second cost category can also be environmentally significant and costly to an organization as it includes the purchase costs of materials inputs converted into NPOs, such as water used in product processing. Using the collected cost information, organization can manage cost-effectively its environmental impacts of its waste and emission levels and possibly consider improving production line to decrease waste per unit product.

PHYSICAL MATERIAL ACCOUNTING		MONETARY COST ACCOUNTING
Materials Inputs	**Product Outputs**	**Cost categories:**
Raw and Auxiliary Materials	Products (including packaging)	1) Materials Costs of Product Outputs
Packaging Materials	By-products (including packaging)	
Merchandise	**Non-Product Outputs (Waste & Emissions)**	2) Materials Costs of Non-Product Outputs
Operating Materials	Solid Waste	
Water	Hazardous Waste	
Energy	Wastewater	
	Air Emissions	
		Other cost categories:
		3) Waste & Emission Control costs
		4) Prevention and other Environmental management costs
		5) Research and development costs
		6) Less tangible costs

Figure 3. Physical material accounting and cost categories (modified from IFAC 2005).

Other cost categories mentioned by IFAC (2005: 38) and illustrated in Figure 3 at right-bottom are (3) Waste and emission control costs that cover the costs of handling, treating and disposing of the waste and emissions as well as compliance costs related to waste and emissions control. (4) Prevention and other environmental management costs cover preventive environmental management activities such as green purchasing and extended producer responsibility. It also includes costs of environmental planning and systems and environmental communication where as (5) Research and development costs include for example development of energy-efficient products.

Both internal and external less tangible (6) costs, aslo referred as "difficult-to-quantify costs", are usually hard to track from information systems but can be significant, for example liabilities and costs arising from future regulation. It is always difficult to prepare on future regulation and hard to assess when externality is no longer external and should be internalized in organization through provision. Even though externalities are less tangible and difficult to quantify, it is very important to understand them and try to estimate the monetary effects in order to avoid negative surprises. (IFAC 2005: 48–52). Bartolomeo et al. (2000: 33–34) mention that in Europe, environmental liabilities are not equally enormous than they might be in American companies due to a differing legislation, but it is important to notice that environmental legislation develops continuously and may become more rigorous over times.

The accuracy of recording environment-related costs depends on organizations' goals and the level of data available. Double booking should be avoided in order to get reliable total annual environment-related costs. In contrast, to account for environment-related earnings such as sales of scrap or waste, higher profit margins from "green" products etc., savings realize only when a current system changes in some way and it is possible to calculate e.g. reduced costs compared to the previous costs. It is also worth noticing that sometimes a driver for project with positive environmental goal has also other goals in the area of quality or efficiency, which supports the EMA definition where both environmental and economical benefits are desired by using EMA. (IFAC 2005).

To summarize, physical environmental information gives information of company's impact to natural environment. Assumedly companies are also interested of the economical effects of the environment related matters, which indicates the monetary aspects being included to management accounting field. Therefore, the second research question is

Q2) What *monetary* environmental information (MEMA) the case company currently identifies and collects from its business operations?

3.4 EMA methods and tools

Debnath et al. (2012) attempted to emerge the history and methodological development of EMA in their research covering literature review and analysis of available EMA case studies. They identified several methodologies of EMA use that were categorized under *accounting based* (capital project & budget analysis; supply chain costs with material flow costing (MFCA); wastage accounting) and n*on-accounting based* (input-output methodology; total cost framework (TCA); quality cost framework; statistical costing technique) methodologies.

However, Lang et al. (2005: 144–145) introduce another way of categorize environmental accounting methods. They divide the environmental accounting methods according to their purpose and focus in product or process-oriented methods. The product-oriented methods focus on the environmental aspects of the products by providing information for environmental product design. One of the most important product-oriented methods is life cycle assessment (LCA). Examples of process-oriented methods are corporate input-output balance, environmental performance indicators (EPIs) and flow cost accounting, which all are focused on the environmental aspects of the production process in industry, especially material and energy flows. It is important to notice that different methods have their differences but they also overlap in some functions. Thus it depends on the company and its need of information that determines which methods are most useful.

Environmental cost accounting is more conventional approach to environmental accounting as it focuses on the cost side of environmental protection actions covering costs created and costs avoided. Physical benefits from improved environmental performance are ignored but newly sub-discipline of EMA, environmental performance measurement tries to fill this gap. A clear trend is seen to move from cost accounting towards material flows and related environmental impacts, which are measured through eco-efficiency indicators. From this perspective, environmental costs can be defined as the sum of all costs that are directly and indirectly related to material and energy use and their resulting environmental impacts, including fees, fines, procurement, and

administrative costs caused by environmental regulations. (Schaltegger & Wagner 2005).

3.4.1 Environmental cost accounting methods

The field of different environmental costing methods is diverse and this chapter mentions only few perspectives. One of the methods is full cost accounting (FCA), which is conventional method that records direct costs and allocates indirect costs to a product, product line, process, service or activity. Some applications include only company's internal costs, which impact the company's financial result while other applications may include even external costs from product's lifecycle that have no direct or indirect effect on financial result. Traditionally environmental costs have seen only as costs caused of environmental protection, but full cost accounting involves also future costs such as environmental risks and liabilities. The advantage of full cost accounting is the possibility to allocate environment-related cost on the basis of the activities that cause costs. On the other hand the disadvantage of full cost accounting is the cost centered approach that ignores the opportunities in environmental management accounting striving for cleaner production. (Schaltegger & Wagner 2005.)

Another stream of environmental cost accounting is process costing which extends the point of view to cover entire life cycle. In addition to same advantages than full cost accounting has, process costing or activity-based costing integrates environmental cost accounting into the strategic management and encourages managers to track the environmental costs. (Schaltegger & Wagner 2005.)

One of the most developed approaches of environmental cost accounting is process oriented "Flow Cost Accounting" together with other material flow-oriented cost accounting approaches such as "Material Flow Cost Accounting (MFCA)" (IFAC 2005: 31). They were developed in late 1990s, when it was recognized that calculation of environmental protection cost was not sufficient to improve eco-efficiency. The main idea is to gain transparency in material flows, including all the costs before production starting from procurement up to disposal or sale by the company, thus covering the entire production chain. (Lang et al. 2005: 146.) Flow based accounting allows the costs to flow along the production of finished products (Debnath et al. 2012: 47).

The advantages of flow cost accounting are the improved cost information, which helps companies to recognize inefficient material use as well as increasing the mutual

understanding between controlling department and environmental manager, due to mixed focus areas. Controversially, the implementations of flow cost accounting are costly projects, which demands lots of effort and know-how. (Lang et al. 2005: 146-147.)

3.4.2 Life cycle assessment (LCA)

Life cycle assessment is a tool to assess the environmental impacts throughout a product's lifecycle i.e. from raw material purchase to production and again to end-of-life-treatment and waste management. LCA principles and framework are defined in ISO 14040, which unifies the LCA practices even though detailed techniques are outside the ISO standard. LCA gives a comprehensive overview in problem areas where responsibility shifts, for example, from one pace of the life cycle to another, from one region to another or from one environmental problem to another. (Finnveden, Hauschild, Ekvall, Guinée, Heijungs, Hellweg, Koehler, Pennington & Suh 2009: 1.)

When conducting an LCA, the design or development phase of a product is usually excluded, since it is assumed to have only little environmental effects. However, it is important to note that the decisions made in the design/development phase have major environmental impacts in the other life cycle phases. Therefore, LCA study should be conducted as early in the design process as possible. (Rebitzer, Ekvall, Frischnecht, Hunkeler, Norris, Rydberg, Schmidt, Suh, Weidema & Pennington 2003: 702.)

There are four phases in LCA studies: 1) In *the goal and scope definition* the depth and the breadth of LCA study are defined, why and for whom the study shall be made. Also level of details and study boundaries are decided 2) *The inventory analysis (LCI, life cycle inventory)* is crucial part of the LCA study where the consumption of resources i.e. inputs (resources) and outputs (emissions) are quantified throughout the product's lifecycle. 3) *The impact assessment (LCIA, life cycle impact assessment)* provides additional information to help to assess LCI results in order to better understand their environmental impact and 4) *Interpretation* is the final phase of LCA study in which LCI and LCIA results are summarized and discussed as a basis of conclusions, recommendations and decision-making in accordance with the goal and scope definition. Interpretation occurs at every stage in an LCA. In some occasions only life cycle inventory studies are sufficient and the phase of LCIA is excluded. LCI studies are one environmental management technique and similar to LCA, but they are not

supposed to be confused to each other. (Rebitzer et al.2003: 704; ISO 2006; Finnveden et al. 2009: 2.)

Life cycle assessment has history from 1990s and since then it has increased the maturity as a field of study, but the method is still under development. In addition to ISO, there are other international bodies to help build consensus and give recommendations, such as Life Cycle Initiative of United Nations Environment Program (UNEP). It is important to note that several LCA methods are available, which can lead to differences in results and affect to comparability. There are some limitations in LCA that need to be taken account. While LCA is data intensive method, lack of data can restrict the conclusions in LCA study. Also despite the goal of comprehensive view of environmental impacts, not all types of impacts are covered that well in typical LCA, for example impacts on biodiversity or freshwater resources. (Finnveden et al. 2009: 2, 15–17.)

3.4.3 Input-Output Balance

Input-Output balance is based on the underlying assumption that all physical inputs must eventually become outputs – either physical products or waste and emissions – and the inputs and outputs must balance (IFAC 2005: 33–36). It is one of the first instruments developed for environmental management and it has three main purposes in environmental accounting; providing systematic background to identify the relevant environmental aspects, providing information for environmental communication and reporting and being a starting point to identify environmental protection potentials (Lang et al. 2005: 145–146).

Input-Output balance and different input- and output types were presented more in detail earlier in Figure 3 and in chapter 3.2 and 3.3 presenting physical environmental accounting. As can be conclusion, companies should try to track all physical inputs and outputs and ensure that no significant amounts of energy, water or other materials are unaccounted for (IFAC 2005: 30–36).

3.4.4 Environmental Performance Indicators (EPIs)

One popular process-oriented instrument is Environmental Performance Indicators (EPIs), which are included in various guidelines. EPIs are absolute or relative measures

with environmental focus such as measuring amount, mass, costs or other environmentally important figures in a company. (Lang et al. 2005: 145.)

Environmental performance is defined as *"measurable results of an organization's management of its environmental aspects"* in ISO 14031 (2013). Schaltegger & Wagner (2005: 54) propose a similar definition where environmental performance can be understood either in absolute, relative or normative terms: *"environmental performance is the change of a firm's environmental impact over time"*. An example of an absolute EPI is the total amount of waste generated each year. Furthermore, an example of relative EPI is amount of waste generated per unit product manufactured. (IFAC 2005: 32.)

With EPIs, actual performance and targets can be compared in order to strive for goals and targets. EPIs can also be used for environmental communication, especially while contributing external CSR reports. (Lang et al. 2005: 145.) Also monetary information can be combined with physical accounting data in order to create cross-cutting EPIs called "eco-efficiency indicators". Using eco-efficiency indicators, environmental matters can be expressed in monetary terms, which might persuade some managers who are more keen to see economical information, to reduce those costs, that probably also reduces the environmental impact. (IFAC 2005: 41.)

According to Schaltegger & Wagner (2005: 54–59), eco-efficiency indicators are closely related to environmental performance measurement. The idea is to combine economic and ecological information in the form of ratio, where economic measure is as a numerator and ecological measure as denominator. The indicators are recommended to classify according to purpose: indicators can be overall corporate performance, general indicators or specific indicators for smaller activities and they can serve long-term or short-term views. Some examples of eco-efficiency indicators are:

Income / environmental impact added (corporate level indicator)
Net revenue/ greenhouse warming contribution (general level)
Sales revenue of product x / CO2 emissions (specific level, output)
Labor costs/ consumption of gas (specific level, input)

It is important to note that for most actors, these indicators start to make sense only if they are related to objects that are possible to influence. Top management, shareholder and product manager thus have different needs and the indicators are to be chosen

carefully. Eco-efficiency indicators can support decision-making only if they are reliable and calculated the same way, thus information quality and consistency in accounting is essential. Usually eco-efficiency indicators are not sufficient as only method, but must be complemented with other quantitative and qualitative environmental information. Environmental accounting needs both crucial data provided by environmental cost accounting and eco-efficiency indicators to provide meaningful managerial information, therefore the debate should focus on the efficient and effective integration of both. (Schaltegger & Wagner 2005: 58–59.)

3.4.5 Summary of EMA tools and methods

Lang et al. (2005: 147) made an in-depth comparison of the input-output balance, EPIs and flow cost accounting methods and discovered some overlap in their functionalities. From the environmental management's point of view, input-output balance was the only method that gave complete overview of inputs and outputs and thus helped to identify the relevant environmental aspects. On the other hand, EPIs supported the largest number of environmental management tasks including identifying cost saving opportunities and providing information to environmental authorities or sustainability reporting. The study revealed that for many companies, EPIs were used on regular basis to ensure continuous improvements and compliance with mandatory reporting whereas input-output balance was constructed every two or three years or when necessary. This highlights the fact that the combination of two or more methods is essential due to the differences in emphasis. Flow cost analysis itself is complicated method and the implementation demands a lot of effort and know-how, and usually it must be added with physical measures. It is recommended only in companies that fulfill certain circumstances such as high material costs and high benefits for decreasing material losses. Nevertheless, after implementation its sincere advantages are improving corporate cost accounting and exploiting existing eco-efficiency potentials.

In addition to above mentioned process oriented methods, life cycle assessment is one of the most important product-oriented methods (Lang et al. 2005: 144–145), where environmental impacts throughout a product's lifecycle are being assessed. It is especially useful in the problem areas, where the responsibility shifts (Finnveden et al. 2009: 1).

3.5 Comprehensive framework for EMA

Burritt et al. (2002) have proposed a common definition of EMA and a basis on which to map different EMA tools. Their attempt is to fill the gap of lacking general definition for EMA concept, which they see a barrier to wider EMA adoption. They suggest that whereas conventional accounting satisfies the need of managers seeking information about the economic performance of a company, EMA is needed to "identify, measure, analyse and interpret information about environmental aspects in company activities", that is important information for corporate environmental managers. They also reason that management accounting systems should be designed to respect the fact that different managers may require different information.

Major focus of EMA is to increase management awareness of positive and negative environmental impacts on corporate economic performance. Integration of monetary and physical environmental measures is also a good way to combine corporate economic and environmental targets, for example by introducing ratios of eco-efficiency and similar. It is also good to notice that many physical environmental information measures of productivity exist already in the systems of conventional management accounting, which means that EMA tools can be build on them and it is not always necessary to start from zero in EMA implementation. (Burritt et al. 2002.)

Burrit et al. (2002) have introduced comprehensive framework for EMA, which takes account also aspects of time frame (past, current or future), length of time frame (short-term or long-term) and routineness of information (ad hoc vs routine reporting). Together with internal/external and monetary/physical aspects of EMA, they build up a model (Appendix 1) that provides suggestion of tools for EMA in relevant situation and information need. For example, if company needs information of past oriented environmental information, which have monetary aspects and long-term focus and it is needed on ad hoc basis, company is suggested to design and use environmental life cycle (and target) costing, see box 4 in Appendix 1.

Burritt et al. (2002) have classified different EMA user groups and considered their basic goals and desired information type. It is important to notice that different managerial levels and departments need different kind of information of environmental issues. Top management strives for development of corporate strategy and is responsible for long-term success and profitability of the company. Accordingly, they likely prefer monetary information that affects strategic decisions on a regular basis as

well as on an ad hoc basis for monitoring individual projects. Top management is likely to be interested of future aspects of environmental issues as well, due to the long-term profitability responsibility. Thus the EMA tools in boxes 6 and 8 (see Appendix 1) are relevant. In contrast, divisional management or production management has different, more specific needs of information and they should be provided this special information by using different EMA tools.

Main advantages in comprehensive framework of EMA are classification of monetary and physical measures, mapping of EMA tools and bringing time frame in to consideration in order to give focus on either short-term or long-term environmental aspects. The framework also benefits managers by considerably clearing the concept and applicability of EMA tools, which will likely to accelerate the adoption of EMA. (Burritt et al. 2002.)

As seen, there are various different EMA methods to choose from. The methods mentioned in this chapter are not full spectrum of choices, but they represent perhaps the most common methods and covers several point of views. It is also good to note, that company's own interest, as well as current and future needs, play an important role when designing an EMA implementation. Usually, more than one method is needed to discover different point of views inside EMA (Schaltegger & Wagner 2005). The third research question aims to map the environmental management accounting tools used by the case company. Furthermore, the fourth research question tries to identify and describe the reporting and analyzing practices for environmental information.

> Q3) Which *EMA methods or tools* have been implemented and how are they applied in a case company?
>
> Q4) How physical and monetary environmental information is being *analyzed and reported*?

3.6 EMA in practice

Previous chapters have presented the theoretical background of EMA, the main concepts of EMA, overview of EMA as a discipline, overview to EMA tools and methods and also the comperehensive framework of EMA. As the main purpose of this research is to explore the current EMA practices in the case company in a profound way

and enrich the understanding of EMA as a phenomen, also the previous literature is reviewed with in-depth point of view. Therefore, some practical examples found from the prior academic studies are introduced next.

Prior research of EMA has mainly concentrated to normative arguments and praising the benefits of 'greening' of management accounting and only small, but growing part of studies has extended to investigate current practices of EMA (Burritt, 2004; Ferreira et al., 2010; Christ & Burritt, 2013.)

The way EMA has been exploited in organizations in practice can be placed into three broad categories which try to illustrate the depth of adapted EMA actions; (1) compliance, (2) eco-efficiency and (3) strategic position. The first category is compliance, which is a stage where EMA is being used mainly to environmental protection through complying external environmental regulation or self-imposed environmental policies. In the eco-efficiency stage, EMA supports the reduction of costs and environmental impacts through improved efficiency in production. It means for example more accurate tracking of flows of water, energy and wastes and minimizing these flows. It can also yield related efficiency projects in a company. The last stage of the use categories is strategic position, which is a point where EMA is being adopted and integrated for company strategy. The target is then to ensure a long-term success by means of designing "green" products, estimating the costs of future regulations and reporting to stakeholders of environmental matters. (IFAC 2005: 24.)

Gunarathne and Lee (2015) follows a parallel three-stage-model of developing the environmental strategy suggested by IMA (1995) presented in chapter 2.3. The idea corresponds to IFAC model and their study attempts to identify and report how a case organization is positioned in the different environmental strategy stages and how the actual stage transformation has occurred. The study by Gunarathne and Lee (2015) is exceptional as being a longitudinal study, which helps to see the actual steps and EMA actions that are made by one organization.

Gunarathne and Lee (2015) present how the case firm adopted EMA practice in the different development stages. The case organization is hotel chain, which initially had launched some miscellaneous environmental saving actions (stage 1), but after a financial crisis in the hotel sector and reduced clients, they were forced to make wide cost savings. While they decided to concentrate on environmental related cost savings, they adopted first EMA actions through energy and water accounting (stage 2). After

successful results, the hotel further developed their environmental policy and actions and moved to final integrated level of long-term sustainable strategy (stage 3). Eventually the environmental actions were part of organizational culture and integrated in to daily management process. The study highlights the improved customer image, which acts as the catalyst to attract green-conscious tourists and, on the other hand, pushes the firm to maintain the environmental policy. It also reminds that the employee support is crucial when aiming at success in EMA adoption.

Another example of EMA use in practice is Ferreira et al.'s (2010) exploratory analysis of the relationships between strategy, EMA use and innovation. It also contributes by developing a research instrument that measures EMA use. One aspect of the study is to measure empirically the perceived benefits of EMA use. Ferreira et al. (2010) use classification of strategy type in order to investigate the relationship to higher amount of innovation. They had found evidence of many benefits of EMA use from earlier literature, for example cost reductions, improved product pricing and reputational improvements. They reason that EMA would bring different information for decision making, which may reveal hidden opportunities and further increase competitive advantage. Therefore, they suggest that EMA use also leads to higher amount of innovation.

Ferreira et al. (2010) conducted a survey with multi-item questions to industries, which were seen as great users of natural resources. EMA use related question consisted of 12 items, which aimed to give understanding of company's EMA activities. Some of the items covered monetary aspects of EMA, while others referred to the physical aspects, as proposed by Burritt et al. (2002). It asked respondents "Please indicate the extent to which your company has done each of the following in the past three years: " on a seven-point Likert scale with three anchors: "Has not done at all", "Has done to some extent", and "Has done to a great extent". Christ and Burritt (2013: 168) used the same question model in their research of EMA use but they added one item in the list. The full, modified 13-point question format listed next, will also be utilized as a part of the empirical data collection in this study.

(1) Identification of environment-related costs.
(2) Estimation of environment-related contingent liabilities.
(3) Classification of environment-related costs.
(4) Allocation of environment-related costs to production processes.
(5) Allocation of environment-related costs to products.

(6) Introduction or improvement to environment-related cost management.
(7) Creation and use of environment-related cost accounts.
(8) Development and use of environment-related key performance indicators (KPIs).
(9) Product life cycle cost assessments.
(10) Product inventory analyses.
(11) Product impact analyses.
(12) Product improvement analysis.
(13) Assessment of potential environmental impacts associated with capital investment decisions.

The analysis in Ferreira et al's research (2010) suggests that EMA use has positive association with process innovation but not with product innovation. Even though the results are not statistically so significant than expected and there are limitations in generalizing the study, the research succeeds to introduce a new research instrument to measure EMA use with the multi-item construct. Also, the empirical evidence on perceived benefits of EMA use were captured.

A study by Christ and Burritt (2013) of accountants' perceptions of EMA in present use and future outlook forms another example of EMA practices. The study anticipated to get greater understanding of EMA in practice by investigating whether the following contingent variables have influence on EMA use in organizations: environmental strategy, organizational structure, company size and industry. Their research was based in contingency theory and aim was to identify key organizational contingencies influencing EMA adoption. Research was executed by asking accountants' perceptions of current and future roles of EMA in their respective company. The same multi-item question construct developed by Ferreira et al (2010) was used in their web-based survey. When analyzing the results, it is worth noticing that according to literature, environmental surveys are better responded when the company already is proactive environmentally (Christ & Burritt 2013: 171).

In the research by Christ and Burritt (2013), the result indicates that EMA is not implemented in practice so widely than theories would suggest. The future role of EMA was evaluated slightly higher, which indicates that accountants believe that EMA adoption will get more attention during next 3 years. The hypotheses of different organizational contingencies were tested and the analysis revealed that environmental strategy, industry and size did significantly predict the EMA use. It means that if

environment is involved to corporate strategic plans and goals, or if the company is in environment-sensitive industry or large at size, it is expected that EMA is more likely adapted.

According to Christ and Burritt (2013: 170) the overall perceived level of EMA use reported was found to be very low. It is contradicting, as in academic researches EMA benefits seem to be inevitable. Therefore, they suggest further research of the reasons why many organizations are failing to engage with EMA activities (Christ & Burritt 2013: 171). Kumpulainen & Pohjola (2008: 489) reported critical failure factors in EMA implementations in their case study. They mention the lack of management support and insufficient resources allocated, too narrow project group in EMA design and development, unclear or missing quantification of added value and technical problems with implementation. Also company's industry may provide challenges if the core operations do not have clear environmental effect or if the end-customers are not close. Rapid changes in the business environment may complicate the EMA development as well.

On contrary, EMA success factors have been explored through longitudinal case study in Finland. The result shows that important drivers for successful EMA implementation are innovative attitude and motivated key personnel, transparent internal/external goal setting and a gradual EMA development. Human resources have significant impact since management support and sufficient resources as well as broad involvement of personnel in different departments were highlighted. Other success factors were also value-chain or long-term thinking, benchmarking of other companies or EMA guidelines and anticipating future requirements. (Kumpulainen & Pohjola 2008: 489.)

The study of Christ and Burritt's (2013) has also inspired this study to investigate the present role of EMA in one organization. Similar approach is desired with the distinction that the EMA roles are supposed to be investigated through in-depth analysis of one company and the future outlook is excluded. In general, small amount of existing studies of the current practices of EMA, especially in Finnish context, bring the motivation to this research and the aim is to increase understanding of the factors affecting EMA use.

3.7 Benefits and challenges of EMA use

The basic purpose of using EMA is to provide information to management that can be useful for environmentally sensitive internal decision-making. In practice, this information covers physical information of flow and stock of materials, energies and wastes, as well as financial data of environment related costs, potential earnings and possible savings generated in the organization. (Debnath et al. 2012: 45.) According to IFAC (2005: 23), EMA is particularly beneficial to internal management initiatives with environmental focus, for example cleaner production, supply chain management or "green" product development. It is worth noticing that EMA-type information is increasingly being exploited for external reporting purposes as well and EMA is becoming more important for all types of management activities where environmental issues affect to regular business decisions.

Debnath et al. (2012: 45–46) could also identify more detailed purposes for EMA use. New areas of cost measurement refer to the fact that conventional accounting is not sufficient to analyze costs that are uncertain, contingent, non-traditional and mostly hidden and therefore, new methods are needed. EMA is also likely to improve cost analysis through new methodologies of cost identification, calculation and information generation. For example, identification of cost drivers that relates to wastes helps the evaluation of total garbage disposal costs and may lead to cost savings. Yet, Debnath et al. (2012: 45–46) mention, that with the help of EMA methods like life cycle analysis (LCA) and full cost accounting (FCA), managers can seek more environmental conscious alternatives. Thus, EMA supports strategic decision making when choosing environmentally responsible capital investment decisions. EMA is also useful for environmental performance management through eco-efficiency, which was discussed earlier in chapters 2.4 and 3.4. Also sustainable balance scorecard model are used to connect individual performance management to environmental matters.

Ferreira et al. (2010) examined perceived benefits of using EMA in organizations. Their survey tried to assess the following 15 commonly experienced benefits of EMA use based on the literature review: (1) Increased demand in "green" products, (2) Increase in product margin, (3) Increase in customer satisfaction, (4) Cost of capital reduction, (5) Insurance cost reduction, (6) Operating cost reduction, (7) Identification of new opportunities, (8) Generation of process innovation, (9) Generation of product innovation, (10) Attraction of better quality staff, (11) Improvement in productivity,

(12) Improvement in reputation, (13) Improvement in decision making, (14) Product costing improvement and (15) Production process improvement.

The result of the survey reveals that identifying new opportunities, improvements in decision-making and in reputation are the most experienced benefits of using EMA. Identification of new opportunities refers to the fact that more information helps to identify new hidden opportunities in business e.g. new product innovation or better waste management process. Organizations generating CSR reports also develop better internal control systems that affect positively to decision-making processes. Reputational improvements involve better relationship with stakeholders and better corporate image may arise from good citizenship behavior or offering environmentally friendly products. Environmental cost savings may be a result of implementing EMA and allowing better environmental cost identification, classification and allocation as well as advanced cost analysis. (Ferreira et al. 2010.)

Despite of EMA benefits, many academic studies have reported low levels of EMA adoption even though the advocating literature is available and highlighting various benefits of using EMA. The cost of implementation of comprehensive EMA versus the gained benefits has also been criticized. Some companies claim to use EMA, but actually the procedures are far from systematic and comprehensive implementation. (Christ & Burritt 2013: 164–165.)

Environment-related data may be difficult to collect and evaluate from conventional management accounting systems, which may lead to a situation where managers misunderstand negative financial consequences of poor environmental performance or the benefits of improved environmental performance remain hidden. Typical challenges in EMA use are underdeveloped communication between accounting and other departments; environment-related costs are hidden in overhead accounts; materials use, flow and cost information is not tracked adequately; many types of environment-related cost information are not found in the accounting records; investment decisions are often made on the basis of incomplete information. (IFAC 2005: 26). In addition to what IFAC (2005: 26) mentions, Burritt (2004: 15) found even more problems when investigating conceptual and practical problems and challenges encountered when using EMA. Moreover, he compares academic and practical answers to the problems such as 1) Environmental costs are assumed not to be significant, 2) Performance appraisal techniques are too narrow and short term in their focus, 3) Lack of attention to articulation of stocks and flows, 4) A narrow focus on manufacturing, 5) Dominant

financial accounting rules, 6) Motivational effects and 7) Absence of accounting for externalities and social cost issues

The last research question tries to find out, what kinds of challenges are perceived in the field of EMA in the case company. In addition, there is a target to identify new opportunities that would improve the existing EMA practices. Therefore, research question is stated as:

> 5) What *challenges* exists in EMA use and what kind of *new opportunities* can be identified in the case company?

3.8 EMA practices in Finland

Possibly the first attempts to develop EMA systems in Finland was Tuula Pohjola's doctoral dissertation in the mid- 1990s. It consisted of ten pilot projects in six Finnish companies. Later in 2005 a follow-up case study was made with four of the same pilot companies, which provides valuable long-term information on the development of EMA practices. The follow-up study revealed that only one of the case companies had voluntarily and successfully developed its pilot EMA system while others had discontinued it due to lack of motivation and time. Therefore, the follow-up study gives valuable insights to the success factors in developing EMA, which were discussed earlier in chapter 3.4. (Kumpulainen & Pohjola 2005.)

Kumpulainen and Pohjola (2005) conclude that in addition to the one successful case company, there probably are not many other Finnish companies that would have voluntarily developed their EMA practices. They mention that fundamental reason for this is that environmental issues are not considered to be integral part of the business processes and are carried out rather to satisfy environmentally conscious stakeholders.

During the last ten years the environmental focus in companies has assumedly increased, at least the impression is strong when browsing through company annual reports consisting loads of information on environmental matters or even separate social responsibility reports. Literature on EMA in Finland is still hard to find, but some exceptions that cover EMA or it's sub disciplines are fortunately found. For example, Ilpo Penttinen (2012) has made a doctoral dissertation of eco-efficiency adoption in

Finnish SMEs including recommendations to how to adopt eco-efficiency into operational and strategic management.

The small amount of existing literature and the lack of common procedures and concepts of EMA in Finland brings motivation to this study where the aim is to make in-depth analysis of one company and its environmental processes, procedures and accounting methods. The goal is to increase understanding of EMA practices and make recommendations to the case company on possible development paths to follow in the field of environmental management accounting.

3.9 Summary of research questions and framework

According to Yin (2003: 28) theory development is crucial before jumping in data collection in case study approach. Theoretical propositions guide researcher to make appropriate choices of research design and particularly data collection and analysis.

Previously chapters 2 and 3 brought understanding of the concepts including to EMA and the relevant aspects, or themes, which have been identified from earlier literature. Next in chapter 4 the methodological choices of this research will be discussed and the empirical findings are followed in chapter 5. Moreover, in chapter 6 the conclusions are drawn together and the research outcomes, limitations and future prospects are discussed finally in chapter 6. The summary of the research questions, that forms the foundations to the empirical research, is as follows:

> Q1) What *physical* environmental information (PEMA) the case company currently identifies and collects from its business operations?
>
> Q2) What *monetary* environmental information (MEMA) the case company currently identifies and collects from its business operations?
>
> Q3) Which *EMA methods or tools* have been implemented and how are they applied in a case company?
>
> Q4) How physical and monetary environmental information is being *analyzed and reported*?
>
> Q5) What *challenges* exists in EMA use and what kind of *new opportunities* can be identified in the case company?

4 METHODOLOGY

Research process is a multi-stage process consisting different phases such as formulating and clarifying the topic, making the research design, choosing the sample and collecting and analyzing the data (Hirsjärvi et al. 1997: 267–268; Saunders et al. 2007: 8). In this chapter, the methodological choices regarding this research are presented.

The basis of qualitative research is to describe real life situations where attention is pointed in quality and meanings. While trying to build a comprehensive view, the essence of qualitative research is "to find and reveal facts" rather than to verify already existing claims about truth. (Hirsjärvi et al. 1997: 161–162.) The written part of qualitative research has been described as "a narration, which has forward going storyline", where writing itself has more crucial role than in quantitative research (Hirsjärvi et al. 1997: 266–267). Furthermore, Saunders et al. (2007: 145) notes, that the word "qualitative data" is often referred as a synonym for any data collection technique or data analyzing method that creates non-numerical data, on contrary to "quantitative data" which specifically deals with numerical data. Yin (2003: 15) also points out, that a case study strategy does not automatically imply qualitative research, but instead, case studies can be composed of both quantitative and qualitative evidence

Saunders et al. (2007) present "the research onion" which describes different phases or layers of a research, moving from broad question of research philosophy inwards to more detailed questions of method and data collection. It is good to understand the foundations of the research in order to examine and challenge the taken-for-granted assumptions. Next the different elements of research onion are briefly presented and later in this chapter, a research onion applied to this particular research is presented (Figure 4).

In this research, the question of epistemology includes the views of interpretivism, where the necessity for the researcher to understand differences between humans as social actors is highlighted. Crucial is, that the researcher adopts an empathetic way of making research and understands the world of the research subjects from their point of view. Social world of business and management is held complex and therefore interpretivist perspective is much used among business studies. (Saunders et al. 2007: 102–107.)

This research applies abductive approach, as the data collection framework was build based on previous theory of the subject. At the same time, the data analysis has a special role to build an understanding of the current practices of EMA and reflect the earlier theories, despite the fact that the research does not include hypothesis testing. According to Tuomi and Sarajärvi (2002: 97–99), abductive approach includes some initial theoretical thought, which leads the data collection and analysis. However, it is not purely data driven or theory driven, but a smooth dialogue between data and theory. To compare, in a deductive approach, researcher first develops a theory and hypotheses and then tests them, whereas in the inductive approach, researcher first collects data and based on that, develops a theory. It is also possible and even favorable to combine the research approaches. (Saunders et al. 2007: 117–119.)

4.1 Research design

Research design includes decisions about research strategies, research choices and time horizons. Exploratory study tries to find out what is happening, seeks new insights and assesses phenomena in a new light. It is particularly useful if the nature of the problem is actually unclear. Exploratory study demands flexibility from the researcher to change direction as a result of new data and insights and accept that the focus of the study may be initially broad and becomes narrower as the research progresses. (Saunders et al. 2007.) Exploratory study can be connected to any of the research strategies (Yin 2003.) As referring to Figure 4, this research is exploratory study where the target is to discover some new insights of EMA usage and shed light on current practices processed in a real manufacturing company. Due to the unclear focus in the beginning of the process, the initial positioning of research questions has been modified during the process.

Case study approach will be applied in this research. Case study as a strategy is recommended if a researcher wish to gain a rich understanding of the context of the research and the related process. Moreover, the different strategies are not mutually exclusive, but can be used simultaneously, for example, a survey strategy as a part of a case study. (Saunders et al. 2007: 135). The more detailed definition and requirements of case study are presented by Yin (2003: 13–14): Case study involves an investigation of a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are unclear. Case study tries to answer questions dealing with more interesting variables than certain data points.

Regarding data collection and analysis method, mixed-method approach is applied in this research. Thus, qualitative data are being analysed with qualitative methods, covering the majority of theis research. One part of collected data is in quantitative form, which inquires also some quantitative aspects of analysis. Many sources of data are used for data collection: semi-structured (theme) interviews (Hirsjärvi & Hurme 2001), interviewer-administred questionnaire (Saunders et al. 2007: 357) and documentary written materials (Saunders et al. 2007: 249). This research is cross-sectional, as it is trying to describe the *current* situation of EMA use in case organization. (Saunders et al. 2007: 147–148.)

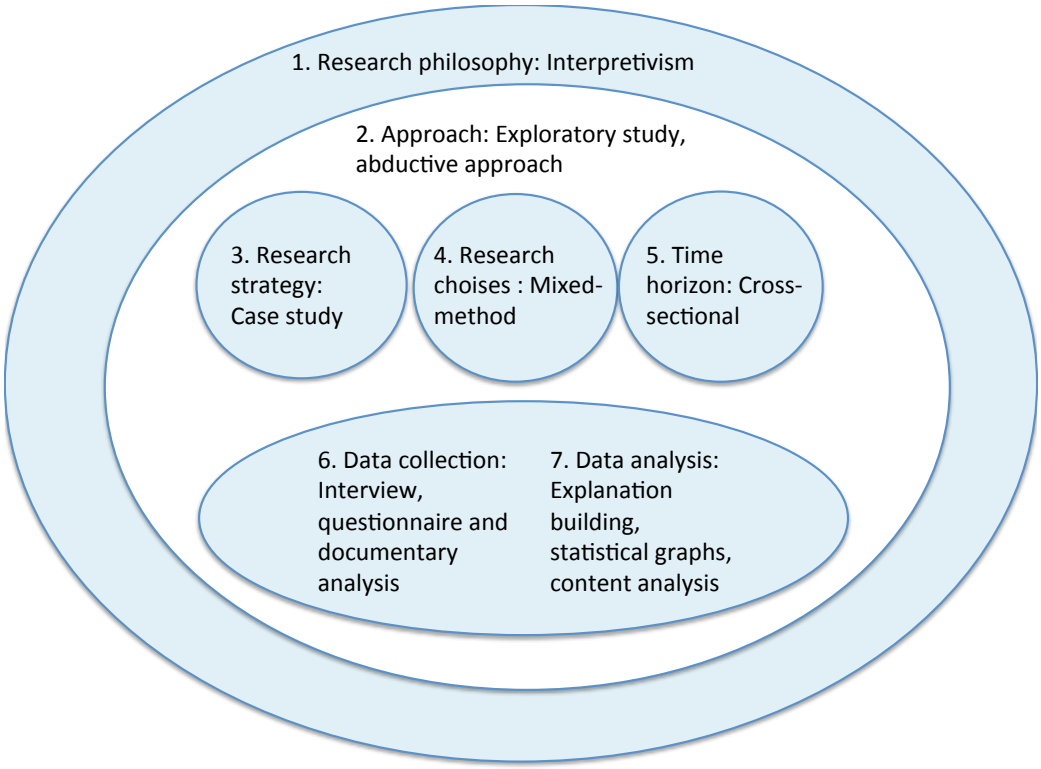

Figure 4: Research choices (modified from "research onion" by Saunders et al. (2007))

4.2 Data collection

Semi-structured interview, interviewer-administered questionnaire and documentary analysis are data collection sources used in this research. Obtaining evidence from multiple sources is highly recommended when conducting a case study (Yin 2003: 14). Also know as "triangulation", the use of many sources of data increases the realibility of

the research, if the data is consistent (Saunders et al 2007: 139). Next these methods as well as some preparation tasks are defined more in detail.

4.2.1 Preparations for data collection

Both Yin (2003: 57) and Hirsjärvi & Hurme (2001: 54) proposes good preparation for data collection process and reminds the difficultness of case study research due to the absence of routine formulas. The preparation methods Yin (2003: 57) suggests are practicing desired skills of case study investigator, training for a specific case study, developing a protocol for the investigation, screening of case options and conducting a pilot case study. Hirsjärvi & Hurme (2001: 54) divides the research plan in two parts, formulating the research topic and technically conducting the research. They also highlight some means that will help eventually in the real interview situation: learning of the interviewing skills and conducting preliminary interviews in order to test the interview structure (Hirsjärvi & Hurme 2001: 68, 72.)

Here, the desired skills of case study investigator have been studied through literature reading. New insights to interview situation have been detected and paid attention, but the skills have been able to practice in real life only limitedly. Training for the specific case study is done through literature review, which is the basis for chapters 2 and 3. The protocol was planned at a highlevel, but due to time restrictions, details were not included. Screening of cases was skipped as the case company was selected beforehand by getting access to the company through personal contacts.

Pilot case study was conducted in a form of few short interviews for professionals in the field of environmental accounting. These interviews of one Finnish academian and one private company member both work elsewhere than in the case company. In addition, a third participant's answers were not reached in time before the actual interviews. Short interviews were conducted through telephone conversation and the essential purpose was to get familiar with the themes for the actual interviews as well as get new insights of the subject. These pilot interviews were found very valuable in the research process and they also led some "last minute changes" in the question layout.

Interviewees, which are summarized in Table 1, have been chosen on the basis of who have been thought to have most relevant knowledge of the topic. The contact person, who has been commenting the research questions in early stage to ensure suitable fit to company's interest and policies, has also helped organizing the interviews. This contact

person is an employee of the parent company of the particular case company, and has not participated in the actual interview sessions. In the beginning of the empirical process it was unclear how many interviews are needed to get sufficient amount of data to answer research questions. It was decided first to agree three initial interviews, which were held in October 2016. The interviewees received an interview guide (appendix 2) few days before the actual interviews. Questions were not written in detail, but a list of themes was included in the interview guide.

After starting analyzing process, it was identified some additional needs for case company insights of the topic and therefore one interview was conducted in the beginning of November as telephone interview and one more interviewee was reached by e-mail to give some detailed information. All interviews lasted 35 – 65 minutes each and were held in Finnish, except the e-mail conversation was written in English. One informant was usually met at a time, except one interview session, which had two participants. In the quantitative analysis part, the answers from the pair interview are recognized as one, since the reasoning and the evaluation was done collectively, not by both participants separately. Thus, the total sample size in the quantitative analysis is 5, instead of 6, which is the total amount of informants.

The interview and informant details are summarized in Table 1. The first stage interviews were structered similarly and they were fully transcribed to a text form for analysis purpose. Altogether 35 pages of transcribed text were completed. The second stage interviews were more focused on themes that were remained unclear and needed more attention. The phone call was recorded unsuccessfully, but notes were written during the interview call. Even though the notes were written directly with word processing programme, not entire conversation could be captured. The answers from last informant were received via e-mail. Due to the specific and narrow research subject, the amount of knowledge is focused on limited amount of employees in the company, which reasons the quite small amount of interviews. Total amount of informants were 6, which included 3 face-to-face interviews with altogether 4 informants, 1 telephone interview and 1 exchange of e-mails.

Table 1. Data of interviews and informants.

Interviewee	**Job title**	**Interview date**	**Interview length**
P1	Operations Director In case company	17.10.2016	65 minutes
P2 P3	QEHS Manager in case company QEHS Specialist in case company	17.10.2016	47 minutes
P4	Finance Director In business unit	18.10.2016	35 minutes
P5	Sustainability Manager In business unit	9.11.2016 (phone)	57 minutes
P6	Business Controller in Operations In case company	18.11.2016 (e-mail)	–

4.2.2 Interview-administrated questionnaire

One part of the interview was conducted using "interviewer-administrated questionnaire", where one set of questions were predetermined and the available answers options were given (Saunders et al. 2007: 312). The questions were mainly applied directly from the research instrument measuring EMA use, developed by Ferreira et al. (2010) and complemented by Christ & Burrit (2013: 168), which was presented earlier in chapter 3.5. Two of the original questions were not used at all due to assumed overlap between other questions. It is worth noticing that since the original questions were in English and translated for the interview in Finnish, it is possible that the entire message of each question might not have been able to capture in translated question. In addition to these 11 questions from existing research instrument, five new questions were added particularly for this research in order to widen the scope. According to proposition by Ferreira et al. (2010) the new questions in the research instrument covered mostly the physical aspects of EMA. The final research instrument (appendix 2) used in this research contained total of 16 questions, of which 9 covered monetary aspects of EMA, 5 covered physical aspects and 2 questions related to both monetary and physical aspects of EMA.

This interviewer-administrated questionnaire part of the data collection was designed to gather data to answer the first two research questions (Q1 and Q2) of what physical and

monetary environmental information is being collected in the case company. Furthermore, the aim was to be able to categorize the data using basic statistical methods such as graphs. The answer options for the mentioned procedures were 1=is not in use at all, 2= is somewhat in use or planned to use, 3= is in use or 4=person does not know of the use.

4.2.3 Semi-structured interviews

Interview is a general term for several types of interviews and crucial is to choose the most appropriate interview type to answer the research questions. Combination of styles is also possible within one interview as long as the strategies are consistent with research questions and objectives. (Saunders et al. 2007: 310–314.) As a fundamental data collection method, the semi-structured interviews were chosen as the purpose was gather merely qualitative data. Semi-structured interviews move forward along different predefined themes, but the actual form and order of the questions varies. Thus, the voice of the interviewees and the meanings they point out to things are the centre of the discussions. (Hirsjärvi S. & H. Hurme 2001: 48.)

The content of the interviews were divided on different sections based on the predefined themes. All interviews started with some background questions of the interviewees work descriptions, presentation of the research topic and notions of confidentiality. Next the structured part of interview (see 4.2.1) was conducted to gather data to answer the first two research questions (Q1 and Q2) of what physical and monetary environmental information is being collected in the case company. Next sections covered themes of environmental information analyzing and reporting and EMA methods (Q3 and Q4), and challenges in collecting and reporting environmental information as well as potential new opportunities (Q5). Indeed, the positive outcomes of using semi-structured interview was the freedom to jump between questions impulsively, thus the order of the sections might have varied in some interviewes and some additional questions or themes might have appeared during the interview to be discussed. At the end of the interview, interviewees were given a chance to talk freely something they felt important and which was not covered in earlier sections. Finally, all interviewees were asked permission to be in contact if further questions would arise.

4.2.4 Documentary analysis

Primary data is new data collected specifically for that purpose. Also secondary data is possible to use, which means reanalyzing data that have been previously collected for some other purpose. (Saunders et al. 2007: 246.) When using secondary data it is advised to ensure sufficient source credibility and to consider carefully in which use the data is applied. (Hirsjärvi et al. 1997: 186-189.) In this research, the external CSR reports that are published by the case company will be analyzed. The intension is to gather data, which supports the data derived from other data collection sources. Especially the analyzing of monetary and physical aspects of EMA (Q1 and Q2) was supported with information from CSR reports.

4.3 Data analysis

Prior theoretical propositions are good guides for data collection and analysis and many sources of data, such as observation, interviews and documentary analysis, are preferred to use in combination (Yin 2003: 13–14).
Methods for data analysis should be considered already before the actual data collection, in order to use it as a guide when planning the interview and deconstructing it. It is usual that qualitative research implies diverse set of analyzing methods: there is not just one clearly best method that suits every situation. (Hirsjärvi & Hurme 2001: 135–136.) Analyzing qualitative data may seem difficult as strict formulas or rules are nonexisting, but some usual methods are making themes and types, classifications and content analysis (Hirsjärvi et al.. 1997). These are adequate analyzing methods for my research as well, as the goal is to understand existing EMA practices in a case company.

Analysing process consists of organizing and classifying data as well as synthesing data where the goal is to build comprehensive view of the subject and set the subject in new perspective. The data are to be described (in context), classified and combined again. Hirsjärvi & Hurme (2001: 144-145.) In this research, analysis process has had many stages that partly overlap with each other. Analysis started with reading the transcribed interviews few times and organizing the text by themes. Readings raised some new questions and a need for some clarifications, thus two additional questions or clarification requests were sent by e-mail and answers were received quite soon. In a quite early stage a decision of the additional interviews was made which led to organizing the schedule and listing the themes that were supposed to be further discussed.

The data from questionnaire part of the interview was computed to Excel sheet, where the questions were given categories and the answers were entered numerically. " I don't know" answers were not included to the statistics. Also the importance of some of the questions, assessed by the interviewees, was entered in the table for later analysis. Eventually, quantitative analysis was made for example of most used EMA practices, less used EMA practices, classification of monetary and physical EMA practices and areas of development. The research questions 1 and 2 were based on the analysis derived from the graphs based on the data in the Excel sheet.

Classifications of transcribed texts were first made broadly of nearly all topics that were covered in the interviews. Later, the themes that would be analysed more detailed were reduced to cover the ones that related to predefined themes in order to concentrate what was considered essential. Therefore, some themes were dropped out. Rest of the text would be read several times and based on that, explanations for Q3-5 would be established.

Documentary analysis involved especially the case company's latest corporate social responsibility report from year 2015. It was read through and all environmental related themes were highlighted and they were examined more carefully. Also the data from interviews were reflected and the consistency of interviews and the written documents were evaluated.

4.4 Reliability and validity

The quality of the research can be tested with four different dimensions; construct validity, internal validity, external validity and reliability. In this research, internal validity is not reviewed as it is mainly used in explanatory or causal studies. (Yin 2003: 34).

The use of semi-structured or in-depth interviews can relate to certain data quality issues as reliability, different forms of bias and validity. For example, interviewer bias can be created unintentionally through comments, tone or non-verbal behavior by the interviewer that affect how the questions are being answered. Interviewee bias in turn may appear when interviewee is willing to be interviewed but may still be sensitive about certain matters and thus reveals only partial picture of the situation. (Saunders et al. 2007: 317–320.)

Validity is measuring whether the study results are really what they seem to be. Furthermore, generalizability or external validity is concerned whether the study results are applicable to use in other contexts as well. Generalizability of findings is not usually the intention in qualitative studies or even possible, where the study is based on small number of cases. This is often the situation in case study approach. However, the significance of the research may be increased, if the research project is properly connected to already existing theory and thus the study would test the applicability of the existing theory in a new context. (Saunders et al. 2007: 150-151, 319, 328). The term "analytic generalization" is introduced by Yin (2003: 32) referring to the comparison of empirical results of case study to previously developed theory. He suggests that in case studies, the goal is to make analytic generalization and not be confused with "statistical generalization" which is often familiar from quantitative studies.

Yin (2003) presents four different case study strategies with two dimensions: single/multiple case and holistic/embedded case. Despite of the Yin's (2003) recommendation of using multiple-cases whenever possible in order to have stronger evidence for the study results, this research is chosen to be single-case study investigating one organization. It also tries to examine the global nature of the EMA practices as one unit of analysis, which refers to a holistic design. The rationale for single-case study is the uniqueness of the subject. It is admitted that multiple-case research would increase the research validity, but the research goal of understanding the fundamentals of EMA and discovering new insights requires much attention for one organization, and therefore the available time and resources hinders the research to be enlarged to cover more organizations. In order to increase the external validity, single-case-case study calls for analytic generalizing.

Construct validity is concerned of the correctness of the measures that are chosen to investigate the topic. Some tactics to increase construct validity are to use multiple sources of evidence, to establish a chain of evidence and to ask the key informants to review the research report. (Yin 2003: 36.) In this research, multiple sources of evidence are used in order to gain more confidence in results. Also, chain of evidence exists for example in interviewer-administrated questionnaire and interviews, where the results of the questionnaire are tried to be supported with additional information received via the interview sessions.

Saunders et al. (2007: 143–145) also remind the existence of practitioner-researcher relationship features when the researcher is employed in the organization of research object. It gives advantage by knowing the organization very well, but on the other hand it creates risks of having assumptions and preconceptions of the organization, which may prevent exploring the issues that would enrich the research. In this case, the researcher has formerly worked in the parent company of the particular case company, but at the time of the research there is no employment. Thus it gives advantage for the researcher to know the case organization well, but due to the few years absence, a certain distance has been formed, which may allow more objective view to conduct a research.

Reliability measures how well other researcher would get the same results from the same research made all over again. In order to improve the reliability it is important to clearly state the research strategy and process that allows future researcher understand the decisions made. (Saunders et al. 2007: 317–320.) That is especially important while conducting case study, as the documentation has been poor in case study history. Yin (2007: 38) proposes some tactics to increase reliability in case study approach: case study protocol helping with documentation and the development of a case study database. More generally he suggests conducting the research as if someone were always looking over your shoulder. Here, the reliability has tried to be improved by explaining step by step the data collection process and the rationale for decisions behind the research methods used.

4.5 Case company selection

This research is a single case study of current EMA practices in one organization and the purpose is to capture in-depth information to enrich the understanding of EMA as a phenomenon and how it is utilized in a case organization that is headquartered in Finland. Case company operates in manufacturing business, which is referred as an environmental-sensitive field (Christ & Burrit 2013: 167). Case company is a part of an international group that operates in more than 10 countries and whose headquarters is located in Finland. The turnover of the entire group was 905 million euros in year 2015. This research is concentrating in one subisidiary of the group, which operates in Finland and is referred as “case company”. The case company forms a major share in a business unit, which had turnover of 346 million euro and employed approximately 530 persons in 2015.

The case company has published voluntary external CSR reports for several years and the latest report follows G4 principles. In the light of the information derived from CSR reports, the assumption in the beginning of this research process has been, that the case company is managing environmental matters thoroughly and prioritizing environmental investments and improvents very high. The case company thus has an interesting background to deep-dive to investigate current EMA practices and possible new opportunities and development paths.

5 EMA PRACTICES IN A FINNISH MANUFACTURING COMPANY

This chapter concentrates on key findings arised from the collected data, which are represented in the order of the stated research questions. Data for the first two themes, physical and monetary aspects of EMA, was obtained mainly through interviewer-administrated questionnaire. To clarify, during the interview sessions, the interviewees were asked to evaluate the utilization level of certain EMA activities in the scale of 1–3, or alternatively, they were given a possibility to answer, "I don't know". On one hand, this enabled a basis for quantitative analysis of the activities in use, and on the other hand, it allowed interviewees to give further information and explanations to their evaluations freely. Also the latest external CSR report published by the case company and topic related discussions during the other sections of interviews were used as a source of data to investigate used EMA activities.

The main source of data for the remainding three EMA themes, namely tools and methods, reporting and analysis and challenges and new opportunities, was the semi-structured interviews. The transcribed interviews and notes from other interviews were analysed first by each interview separately and after that by divided to themes according to the original research questions.

5.1 Physical aspects of EMA

The first research question was stated as follows: *Q1) What physical environmental information (PEMA) the case company currently identifies and collects from its business operations?*

According to the annual corporate responsibility report from year 2015, it can be seen that the case company pays much attention to environmental matters. The report consists of several physical flow measures: energy consumption and sources of energy, water consumption, emissions to air, waste amounts and categories as well as packaging mateterial usage. In addition, production amounts (tonnes) are reported. Most of the physical measures are reported with both absolute and relative figures such as waste kilograms as per one tonne of produced items. Emissions to air and sources of energy are reported only with absolute figures.

Besides these measures of physical flows, the case company had also one section of "sourcing" included in the CSR report in 2015. It included more detailed information on responsible sourcing process of the company and other supply chain sustainability aspects. The case company has set goals to increase the share of raw materials from sources ensured to be sustainable (hereinafter referred as "sustainable purchases"), which leads to an interpretation that the case company is giving high emphasis on environment-friendlier and socially responsible raw materials. This interpretation was further supported during the interviews.

In addition to externally reported physical flow measures, the case company follows physical environmental measures also for internal decision-making purposes. The interviewer-administrated questionnaire was targeted to bring insight to different practices of EMA activities, which focus more in internal decision-making in the case company. In Figure 5 the questions related to physical environmental activities are gathered together.

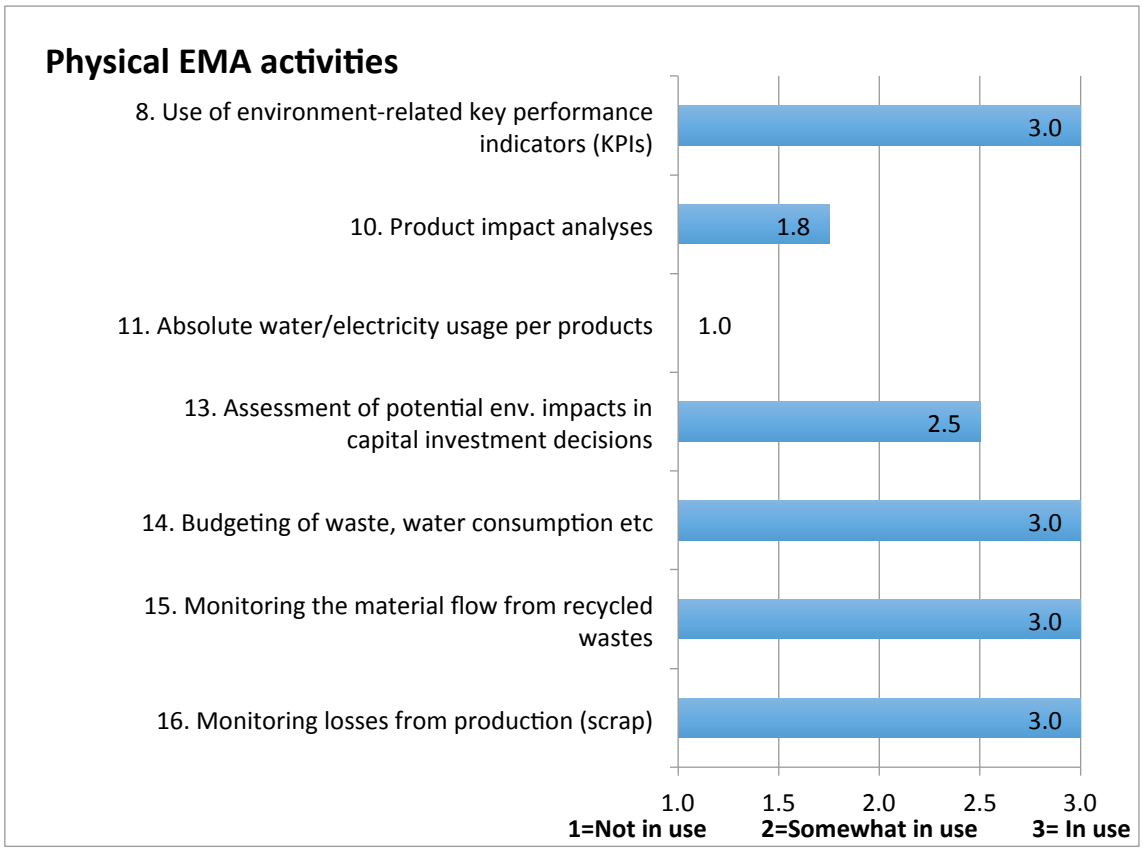

Figure 5: Physical EMA activities in case company.

Totally seven questions covered physical aspects of EMA (Figure 5). The questions 8 and 16 were covering both physical and monetary aspects of EMA where as the others were more related to only physical flows. The question 8 of "use of environment-related key performance indicators (KPIs)" was fully agreed by all applicable interviewees and it scored 3,0. It is important to note that the performance indicators may use only physical information or it may rely both on physical and monetary aspects of EMA. It was mentioned *"Yes, we have KPIs in use and we use production volume as the relative indicator…"*, which refers to physical data indicator. It was also delineanated:

> *"This relates to the monitoring aspect, even that these can be incentives in some cases…also certain indicators are raised little bit higher than other, so they are not just a bunch of indicators, but some are more important than others…"*

It was also mentioned that the indicators had been recently worked through and even some new indicators are going to be introduced:

> *"They (indicators) have been clarified to different levels…for example, a climate impact is a higher level indicator and just below it is related indicators of energy consumption and utilization level of renewable energy"*

The question 10 of whether the case company conducts product impact analyses resulted 1,8 points and slightly varying answers. One interviewee answered 1 = not in use with reasoning that the product level analysis is not being analysed from any environmental aspects. Other interviewees answered 2= is somewhat in use and argumented it with plans of conducting some part of environmental impact analysis for certain products according to life-cycle assessment principles. In this context, the interviewees mentioned "carbon footprint" being the respective method for conducting the future assessment. One interviewee recalled that some kind of assessment would have been done earlier as well. Also, one interviewee noted that the industry is particularly difficult for making environmental impact analysis, since there are no consistent principles in the industry of how to make and what to include to the assessment.

The question 11 of absolute water or energy usage per products was clearly not in use, as it resulted 1 from all interviewees. It was reasoned that any environmental cost accounting was not made in product level; therefore, the physical accounting in product level was also non-existing.

Question 13 of "assessment of potential environmental impacts in capital investment decisions" was more complicated and the answeres varied among interviewees. Two of the interviewees assessed this question as 2= is somewhat in use and two of the interviewees assessed 3= is in use, scoring totally on average 2,5. One of the interviewees was not asked this question. The interviews gave more information of the environmental impacts in capital investment decisions: one interviewee mentioned that assessment is done sometimes, but the process depends on who is managing the capital investment decision. Another called for more accurate information, as now the environmental assessments are made quite roughly:

> *"Good point. Well, we do it in some extension, yes, but as we don't have sufficient detailed data available, this is hard. I think this would need better product level analysis in order to do this properly. But yes, we do this, and "environmental impact" is being included in the investments (decision-making), but the accuracy is not good enough."*

Those interviewees that gave 3 points to this matter reasoned that environmental impact assessment in capital investment decisions is included to the process of responsible sourcing, where the suppliers are required to have responsible values in their businesses:

> *"This is included to responsible sourcing process, so environmental impacts are included to that…so we look for companions who share our values…"*

One real life example was given, where the assessment of environmental impacts was very high prioritized in a major investment. This leads to my interpretation that the systematical evaluations of environmental matters in capital investment decisions are ensured in the supplier level, but more accurate level is assessed "case by case" without clear guidelines. However, the example of major investment shows that assessment is being done occasionally, but assumedly not in all investments. For example, the environmental impacts from desired production maschine compared to another, let alone smaller investments, may not be systematically assessed from environmental perspective.

As seen from company CSR report, the measuring of energy and water consumption and produced waste seem to be everyday procedure in the case company. Therefore, it is quite apparent that these measures are also budgeted on yearly basis, thus the question 14 scored 3,0 in the questionnaire meaning that all applicable interviewees answered 3

= is in use. Another procedure that seems to be clearly in use and scored also 3,0, is stated in question 15: "monitoring the material flow from recycled wastes". It was further clarified in the interview that:

> *"…then we have these differend kinds of wastes that are losses, but they are being recycled. In our case, nearly all waste is recycled or re-processed, so they are not dumped, -they are sorted waste, which have good, or very good re-use possibilities"*

Thus, all waste is being recycled in some way and some of the wastes are even been sold to another party, which uses the wastes as their raw material. Therefore, question 15 actually contains also monetary aspect, the earnings from waste recycling.

Last physical environmental information question 16 in the questionnaire, is stated as: "monitoring losses from production (scrap)". The production losses can also be strongly connected to monetary aspects of EMA, therefore it's not purely a physical flow measure. The deeper discussions during the interviews revealed, that the monitoring of production losses and actions to minimize the lossess are in high priority in the case company. It also seems that the "lean production" mentality is strong in the company and the procedures regarding scrap are in advanced level already.

To summarize and to answer the research question Q1), physical environmental information (PEMA), that the case company currently identifies and collects, include both absolute measures of physical flows, as well as indicators that are in relation to production amounts. More specifically, the case company has identified and collects systematically and ongoing basis information of energy consumption, sources of energy, water consumption, emissions to air, waste amounts and categories and packaging mateterial usage and production amount (tonnes). These measures are followed internally, but also reported externally in yearly CSR report. For the purpose of internal decision-making, case company also collects detailed data of production losses. Company performs budgeting on PEMA information and uses KPIs that include physical measures. Case company involves environmental impact assessment to their investment decisions at some level and has future plans to make more detailed product impact analyses for certain products. Thus, the company is planning to extend their EMA focus to cover some aspects in product level and implement, at least partly, life cycle assessment as well.

5.2 Monetary aspects of EMA

The second research question was stated as follows: *Q2) What monetary environmental information (MEMA) the case company currently identifies and collects from its business operations?*

According to case company's annual CSR report from 2015, the external monetary environmental information is scarce. From the "Finance" part of corporate social responsibility, it is possible to find key figures such as net sales. In addition, raw material expenditures are specified, which can be connected to environmental information. With the information of CSR report, it is possible to self calculate the raw material expenditures per purchased tonnes. One monetary detail given in CSR report is investments in development projects in the field of CSR. The statutory financial statement would include more financial data from the business operations, but they are not inspected in this relation. It can be interpreted that environment-related monetary information is kept as case company's internal information and one component of the competitieve advantage company has, which is why it is used mainly for internal decision-making. According to interviews, monetary information is also given to statistical purposes, which are obliged by the Finnish law, but any individual companies can't be identified from the statistics.

The interviewer-administrated questionnaire was targeted to bring insight to different practices of EMA use in case company. The questions related to monetary environmental activities are gathered together in Figure 6. Total of 11 questions covered monetary aspects of EMA, of which one question, particularly question 3 of "classification of environment-related costs" is exluded from the analysis due to overlapping theme with other questions. The questions 8 and 16 were covering both monetary and physical aspects of EMA and explained in previous chapter where as the others were more related to only monetary costs.

Question 1 of "identification of environment-related costs" was mostly answered with certainty as 3= is in use. It was said, for example, that *"Yes, abosolutely the matters related to natural resources (energy, water etc.) are followed, and both in absolute amounts and costs."* One interviewee answered 2=is somewhat in use, based on the indirect personnel costs not being identified. It was mentioned:

"We don't calculate for example resources – if I spend a half a day (to environmental matters)…we don't have such costs specified. So we don't do any internal cost analysis, where we would put all the environmental costs and analysed them…"

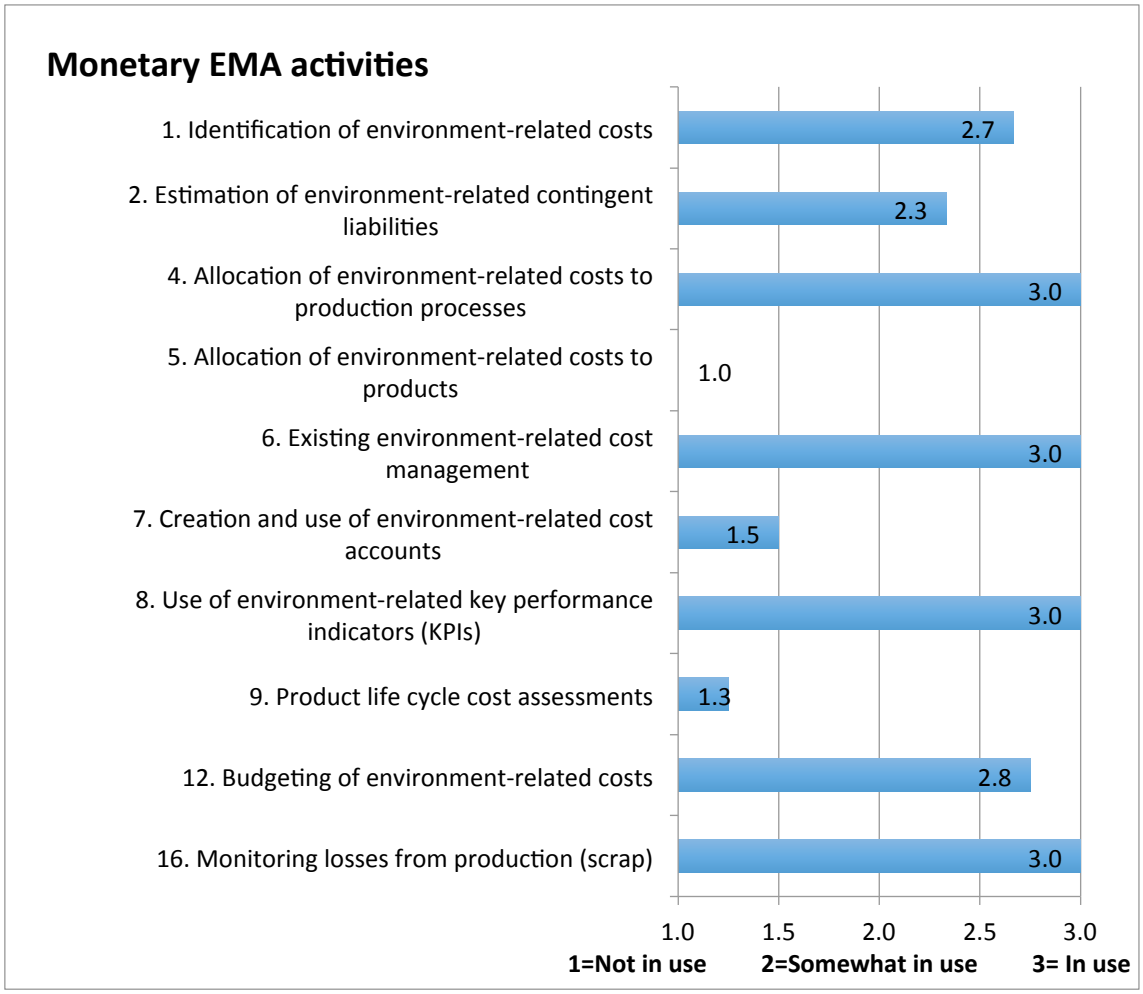

Figure 6: Monetary EMA activities in case company.

In the interview situation, the costs were defined with examples such as electricity or waste costs, or environmental protection costs. This might have limited the seeing of overall cost categories that were presented in Figure 3 earlier in chapter 3.3. However, it was said that: *"We have identified how much does it cost to make "sustainable purchases…"* and another interviewee respected the company's conscious choices to invest in environmental issues: *"We have identified the (higher) cost of the "sustainable purchases", but we want to make a corresponding saving in some other things…"*

Less tangible costs was tried to track with question 2, "estimation of environment-related contingent liabilities". To start with, this question was difficult to clarify to interviewees unambiguously and therefore the possibility of misunderstanding is high. One interviewee answered 3, two of the interviewees answered 2, one of the interviewees answered, "I don't know" and one interviewee was not asked this question. For the interviewer, most difficult was to explain what kind of liabilities was meant since the nature of the possible liabilities is very much future-oriented. One interviewee commented: *"I can't figure out that do we have such emissions now that could create liability to us in future…"* whereas another pointed out: *"..yes, at some level we do that…as we have the environmental systems or procedures…"* . Yet one said the same in another words:

> *"We understand the consequences of our operations, and responsibilities, and we gladly set ourselves assessed by external parties… so I see we are definitely doing something for this matter…but perhaps we could do it a little bit more controlled way…"*

Lastly one interviewee enlightened that the particular core operations done by the case company are not seen affecting that tremendous environmental threats compared to the core products' full life cycle's environmental impacts. Therefore the case company sees that it has only limited possibilities to affect possible future liabilities, and the future events are not so systematically considered:

> *"We are not so far that we would calculate future liabilities by monetary means…but we are conscious about the risks in future, if the environmental matters (in whole chain) are neglected…"*

Questions 4 and 5 relates to cost allocations to production processes and products. It appeared that the case company does allocate environmental costs to production processes in a more aggregated level (answer average 3=is in use), but more detailed level, such as allocating directly to products, does not exist (answer average 1=not in use). For example, water and energy consumption and different levels of production losses (scrap) are allocated to different phases of production processes, of where they collectively and evenly are divided to products. At this point, it can also be noted that production process related question number 16 "monitoring losses from production (scrap)", which was described already in section 5.1, scored answer average of 3.0, indicating that it is being used in the case company.

Questions 6 of "existing environment-related cost management", and question 12 of "budgeting of environment-related costs" can both be seen as parts of a larger environmental cost management system. All interviewees agreed that the case company has existing environment-related cost management activities (answer average 3). It was referred especially to the management of typical environmental costs such as costs of energy, waste and water usage. Again, it was mentioned that indirect environmental costs (e.g. personell costs) were not included. Similarly, the question of budgeting seemed to be clear from physical measures' point of view: *"Basic costs are quite stabile operating expences, which are budgeted as a part of normal operations…".* A responsible person prepares the budget to each cost account based on yearly estimations. Likewise, it is mentioned that the additional costs from "sustainable purchases" are specified in the budget. In the budgeting of other sort of costs there were contradicting comments, for example:

> *"…I think it's a wrong way of doing it (to specify environmental costs to budget)…because everything is then related…if we do things more efficiently, we use less enrgy… and it has direct effect to environment..."*

Question 7 of "creation and use of environment-related cost accounts" relates to cost management as well. It appeared that the highlevel accounts existed for different energy sources and waste categories as a part of total production costs. It is assumed that these environmental related costs are seen as a part of normal operational costs as commented by an interviewee.

Question 9 of "product life cycle cost assessments" scored 1,3, which reflects slightly varying answers, but the emphasis is more in the "not in use" side. The closer analysis of it will be performed in the next subchapter, where life cycle assessment will be covered among other EMA methods.

To summarize and to answer research question Q2), different forms of environment-related monetary information are collected in the case company. Based on results of the interviwer-administered questionnaire and parallel discussions with interviewees, use of environmental KPIs, monitoring of production losses, environmental cost management and cost allocation to production processes represents the most advanced level of monetary EMA activities in the case company. They are more or less parts of the core opearations, where the efficiency and Lean thinking is held important. The aspects that belong more on the field of accounting, such as estimation of contingent liabilities, creating environmental cost accounts and cost identification in full spectrum including

indirect costs as well, are not so systematically implemented to case company's activities and thus, are included to potential development areas described in chapter 5.5. In addition, case company has monetary activities such as environmental related cost budgeting and product life cycle cost assessment, at least for some parts.

5.3 The use of EMA tools or methods

The next research question was stated as: *Q3) Which EMA methods or tools have been implemented and how are they applied in a case company?*

Based on the interviews, the case company relies strongly on environmental key performance indicators (KPIs) or in other words, environmental performance indicators (EPIs) in environmental management. EPIs are followed in different organization levels, for example, top management follows two environmental performance indicators and head of operations several other indicators. According to the interviews, all of the used indicators seem to be physical EPIs, except energy costs are also included in some indicators. Both abosolute indicators are used (for example total energy intensity) as well as relative indicators (such as total amount of waste in relation to production tonnes). It was also mentioned, that some indicators might be as an incentive for employees.

Generally, the EPIs or "key performance indicators" for environment in the case company are chosen for several years at time. Currently the indicators have been renewed and some new indicators were introduced. The structure of the indicators is such that there are some higher-level indicators, for example climate impact, which are then further divided to few lower-level indicators such as energy consumption and renewable energy consumption percentage. It seems that eco-efficiency indicators including also monetary information are not implemented in case company.

Other than EPIs, it seems that the case company does not have systematically implemented any EMA tools. Full cost accounting (FCA) and flow cost accounting couldn't be identified as such from the EMA activities performed by the company. Without being impelemented in practice, life cycle assessment (LCA) and Input-Output balance were discussed during the interviews though, and some of the thoughts and viewpoints of those are presented next.

One interviewee recalled, that input-output balance type of analysis would have been done as one-off nature, assumedly 5-7 years ago, but later there hasn't been active conversation on it, or identified any needs for repeating such an analysis. Therefore, the case company does not currently perform "input-output balance" or "materials balance" type of analysis where physical inputs and outputs are balanced. It was highlighted by two of the interviewees, that the emphasis is to measure and analyze *the change*, thus relative indicators of operations suits best for the case company.

Life cycle assessment generated lively discussions during the interviews, despite the method is not fully used in the case company. Some parts are being included to current practices, like one interviewee expressed:

> *"We have quite stabile prduct portfolio…currently packaging material options are assessed and also end-of-life treatment… but the changes in product portfolio and packagings are slow processes… Anyway, some parts of the life cycle are assessed already"*

In addition, there were some parts of LCA in consideration to implement in future, for example "carbon footprint" or "environmental footprint" type of assessments. And in general, life cycle assessment was seen important topic, despite of the existing industry wide challenges to conduct it.

It was also mentioned in the interviews that external parties are or will be utilized in the environmental management accounting activities. For example, a sort of review of material usage is planned to order from external partner. The review is based on the MFCA (see 3.5.1.), therefore it can be counted as one "environmental costing method" that is planned to implement, at least as a one-off basis. No other environmental costing methods were detected to be in use or in plans. This is also a good reminder that in the specific topics of EMA, it is reasonable to extend the project implementations to external partners instead of conducting everything with own limited resources.

To summarize and to answer to research question Q3), only some, or only parts of, EMA methods or tools are detected to be implemented in the case company. EPIs are used as absolute and relative figures and they form a main tool for monitoring environmental information. In addition, some traces of early steps of LCA are detected, but only for some parts of a product's life cycle.

5.4 Reporting and analysis of EMA information

The next research question was stated as: *Q4) How EMA information is being analyzed and reported?*

Based on the interviews, it was detected five different levels of internal environmental information reporting. It was described as following:

> *"That, how the level of reporting changes depends on what is the organization level…for example top management follows a few key indicators such as energy intensity… When we go lower in the organization, also single matters inside that topic are followed, for example water, gas, electricity…so it goes in more detailed level, towards the production process itself."*

In the top, there are group level indicators for certain environmental information. Next there is a business unit level reporting, where the management team monitors certain environmental key performance indicators (KPIs) together with other financial and operational topics. In addition, another management team with only CSR focus follows environmental matters more intensely. Furthermore, operational level monitors the more detailed environmental matters that relates directly to production, such as waste, energy and water related indicators. Last, there is the administration level, where the raw data of environmental matters is been collected and maintained:

> *"It is absolutely the most important position (in environmental reporting), because many of us use that information. – in other words, one person is responsible of the starting level (data collection), but exploitation of that information is spreaded to several functions"*

It was mentioned in the interviews, that the administration level has been in its existing form for many years, but recent changes in environmental reporting environment have happened in the upper reporting levels. For example, the group level reporting was said to be in its early stage and it was assumed that it would still keep formulating before achieving its steady form and procedures.

> *"The data is more or less the same… the interest (in other levels) has however increased, which is a good thing that there is ineterest… But the challenge is, that do we all interpret the data consistently…"*

All the mentioned reporting levels are passed on monthly basis and business unit management team also has a yearly follow up on environmental matters in more

detailed level. Between all the levels there is some analysis conducted, in order to grasp differencies in trends or seek meanings behind the actual indicators. It was mentioned for example that *"Based on the analyzing data, (we) create preventive and corrective actions."* All interviewees more or less agreed that the controlling of the environmental costs and other information is done systematically. One interviewee commented: "The *fundamental thing is continuous monitoring, continuous improvement, on monthly basis."* And another replicated it by saying:

> *"I would say that it's quite systematic, because in management meeting, we monitor our targets and the development… so it is very systematic, in monthly basis."*

According to interviewees, the harmonizing of the reporting is in the future plans:

> *"I think we have much information on hand…perhaps too much…so we do a lot of reporting to different functions. Harmonizing the reporting is something that we are working with…reporting will more or less be simplified…"*

Some problems in the reporting are encountered also*:*

> *"Due to some delays or late actual invoice receipt, we can't report indicators with 100% accuracy. But more or less we try to get everything in time."*

Apart from internal reporting and analysis, also external reporting in the form of CSR report and reporting for statistical purposes are identified, but they are excluded from closer examination at this research, where the focus is more in internal environmental information.

To conclude and to answer research question Q4), the reporting is done in several levels in the case company and there has been recent increase in the reporting. Currently, the different reporting levels are group, business unit management team, CSR management team, production management and administration and the physical and monetary environmental information is being analyzed mostly on a monthly basis. The analyses are performed between the reporting levels, by seeking the actual reasons behind the figures presented in reports.

5.5 Challenges and new opportunities in EMA use

The last research question was stated as: *Q5) What challenges exists in EMA use and what kind of new opportunities can be identified in the case company?*

The most frequent topic in the discussions of challenges in the case company was the amount of manual data in the environmental reporting. It was seen as a challenge, as it creates untrustworthiness towards the reported figures, as well as the risk of figures being inconsistent in different reports. It was mentioned for example:

> *"The risk of human error is apparent in this kind of model, where we extract one figure to another table just manually – and the challenge is that this information is used in many places… I mean especially the upper reporting levels, not the administrative level... so do they have consistent figures in everywhere, and used similarly…? This kind of multiple reporting, or reporting in multiple places brings its own challenges…"*

Dependence on certain employees is one feature of the risks included in manual data processing. Over the years, the data responsible may have been changed which also may affect to the figures reported. Also some data received from suppliers (e.g. waste processing partner delivers some data) may be unreliable due to mistakes that appear only later.

Another challenge that was mentioned was the limited amount of data, which is being collected. An interesting insight was, that as the company follows the certain aspects regularly, it is possible, that something important remains hidden and will not be detected early enough. It was admitted that the probability is not high however.

In general, when discussed about the information needs with interviewees, there appeared many different aspects. On one hand, none of the interviewees had very strong opinions of which additional data would be needed, but on the other hand, irrelevant or useless information was not perceived as a problem either.

Some interviewees felt, that more detailed data might be interesting to collect, for example energy consumption on daily level:

> *"We have a minimum level (of environmental information collected) here, of which it is difficult to reduce, rather there is something that should be added or specified more…"*

Software system development was also mentioned, first in relation to the development of more detailed information of raw material purchases: *"It is not easy...to create such systems, or update our current systems to be able to manage it…"* Another interviewee commented:

> *"We are a small big company, so it is not obvious, that some tool would be reasonable…where all the data would be in one place – of course it would be great to have everything in place there...But that would naturally increase workload somewhere else…. So that's a discussion that we need to go through internally…"*

Again manual work was raised up in the discussions of development paths:

> *"Actually what we have, is that currently we use too much time for assuring that figures are correct, but we should use that time to think what should be done to the matters behind the figures…"*

One question related to future expectations of environmental management accounting development in 2 or 3 years' perspective. Various aspects, such as automatisation of data collection, life cycle assessment, development of indicators and environmental reporting in general, were covered:

> *"I think we are going to invest in automatisation…I mean that we want to get more automatic data, on continuous basis, that is quite easy nowadays."*

> *"(of life cycle assessment) I am not sure are we going to do it for every product, but we desire to take a look what it looks like and then decide whether it should be continued or not."*

> *"We want to continue this work and improve the way to do it (environmental reporting), since it is the only way to see our impacts…so the measurement with indicators will certainly develop and therefore the need to improve the raw data, in order to keep these actions and thinking in balance"*

> *"In general, the reporting, in other words what is being monitored and how, is going to develop. At the same time, the (external) requirements of authenticity in environmental reporting increase. Also the clarification of environmental performance indicators is on the agenda, where the intention is to combine things…what is environmental effect and what is monetary effect."*

The interviewer-administrated questionnaire was a main source for the empirical findings of the certain EMA activities in research questions 1 and 2. Some of the mentioned activities received diverse assessment of whether they are being used or not. Therefore, it may be inferred, that despite the certain activivity is actually used or not, at

least it is not perfectly clear process, since some interviewees had different views of it. Next those EMA activities that had some dispersion in the answers are presented. Those areas are interpreted to have some needs for improvement in the case company. By improvement, the activity itself is not necessarily meant to be introruced or implemented, but especially in these areas the practices might not be clear and consistent and the improvement may be just to go through the matters and ensure that every employees with environment related responsibilities are aware of these practices and how they are being accomplished in the daily routines.

The detected potential development areas are presented in Figure 7 and the possible future scenarios or recommendations are discussed further in chapter 6. Identification of environment-related costs was chosen as one of the development areas (Figure 7) despite the high scores in the questionnaire indicating that mostly interviewees answered 3=is in use. However, it appeared in the interviews that, for example indirect personnel costs are not identified as environment-related cost, which raised a question whether this "identification" had been mutually understood by all the interviewees, as the question itself didn't include specified list of what kind of costs were meant.

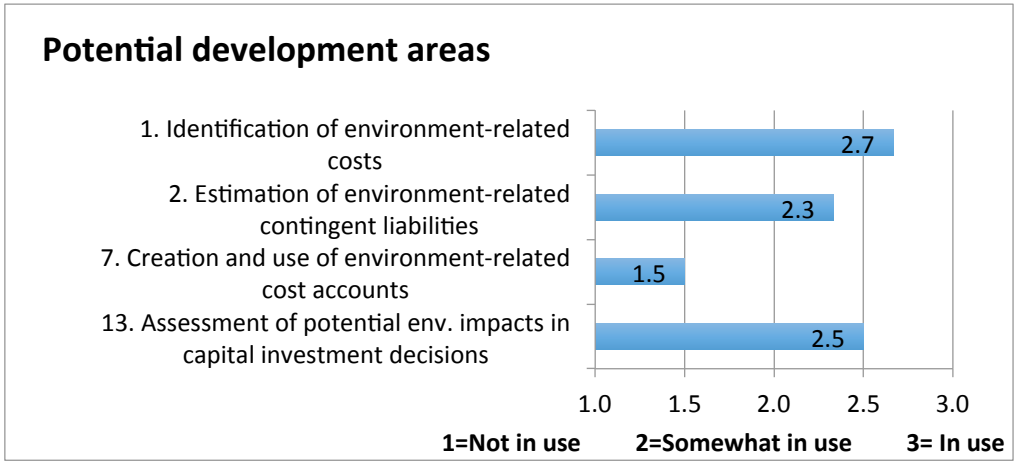

Figure 7. Potential environment-related development areas.

Another development area is the estimation of environment-related contingent liabilities (Figure 7). This can be seen more widely to cover entire cost gategory 6) of less tangible costs explained earlier in the Figure 3 in chapter 3.2. As mentioned, the direct

form and expression of this particular questions varied, as the question itself was difficult and the examples were hard to give. The answers thus varied and it seemed as a topic, which was not included to everyday environment-related work situations.

The interviewees gave evaluated the cost account usage somewhat differently in the questionnaire. Based on the further discussions in interviews, the environment-related cost accounts (Figure 7) can be seen used in highlevel, consisting for example accounts of waste and energy costs. However, due to some contradictive assessments in the questionnaire, it may be worthwhile to go through the policies internally, of the process for posting environmental costs from the accounting perspective.

The question of environmental aspect being involved in the capital investment decision process received also slightly varying answers (Figure 7). It indicates that some kind of environmental assessment is in use for some parts, but the process may not be completely clear or consistent. Therefore, it has been included to the potential development areas for case company.

To summarize and to answer research question Q5), it seems that manual data collection is the biggest challenge in the field of EMA, which increases the risk of human error. Also, the many reporting levels can create unintentional inconsistency in the figures. Some other challenges were also mentioned, but with minor emphasis. Detected potential development areas are (re)identification of environmental costs, identification of less tangible environmental costs and liabilities, (re)defining the environment-related cost accounts and involving environmental impact assessment to investment decision process.

6 CONCLUSIONS

While the previous chapter presented the results of the empirical research, this chapter focuses on explaining interpretations of the results in relation to earlier literature. In addition, it offers some future insights and recommendations to case company.

6.1 Physical and monetary EMA information

In chapter 3.2, it was stated that the Physical Environmental Management Accounting (PEMA) produces information for internal purpose focusing on a company's impact on natural environment (Burritt et al. 2002: 41). In general, the product manufacturing has high environmental impacts, which leads to a need for accurate data on the amounts of all the energy, water and materials used for the whole manufacturing process (IFAC 2005: 30–36). As can be inferred from the results, physical material accounting seems to be at advanced level in the case company and covers all major dimensions of it. By dimensionsions, it is referred to Figure 3 in chapter 3.2, where the model of "input-output balance" was presented. It included different physical material accounting dimensions such as materials inputs, product outputs and non-product outputs. It was highlighted, that organizations should try to track all physical flows and ensure that significant amounts of energy, water or other materials are accounted for. (IFAC 2005: 30–36.)

Moreover, in chapter 3.3, it was stated that the Monetary Environmental Management Accounting (MEMA) produces information for internal purpose focusing on "environmental aspects of corporate activities expressed in monetary units" (Burritt et al. 2002: 41). EMA includes also other important monetary information that is needed to steer cost-effectively environmental performance, therefore the scope is wider than just environmental protection expenditures, which are usually obligated to report by national regulations. (IFAC 2005: 22.) As can be found from the results, there are many monetary environmental aspects that the case company follows. However, the sufficient level of clear and complete monetary information collected in the case company, is not undoubtedly discovered. Next, some related notions are pointed out and reflected towards the general cost categories mentioned by IFAC (2005: 38), which were illustrated in the right side column in Figure 3, already in chapter 3.2.

Accordingly, environmental costs can be divided to (1) Materials costs of product outputs, (2) Materials costs of non-product outputs (NPOs), (3) Waste and emission control costs, (4) Prevention and other environmental management costs, (5) Research and development costs and (6) less tangible costs. It can be inferred from the data analysis, that clearly the case company identifies parts of its environment-related costs, but the accuracy or the classification is not performed in so detailed level than presented in Figure 3. Cost category 3) of waste and emission control costs is monitored without questioning. During the interviews, cost categories 1) and 2) of materials costs retained unspecified by the interviewer and therefore they didn't appear in the discussions. However, it came unquestionably out from the interviews and the CSR report, that materials costs are carefully monitored in the case company and information is probably available in the conventional accounting system. Nevertheless, it seems that materials costs are not perceived as "environment-related" costs and they might not be assessed thoroughly from environmental point of views.

To continue, the cost category 4) from prevention perspective seems to be well thought by the case company, as the intentional increase in "sustainable purchases" fall into this category. In contrast, the environmental management costs, which are included also in cost category 4, seem not to be identified or collected in case company but are included to overhead accounts. Even though Burritt (2004) mentions that lumping indirect environmental cost in overhead account is one of the key challenges in EMA implementations, the transformation of the costing method can't be recommended to case company without restrictions. The costing method transformation would need much more attention than this research may offer, therefore, it is simply recommended the case company to recognize the current way of measuring direct and indirect environmental costs and to examine whether there are any alternatives to amend it in future.

Lastly, research and development costs in cost category 5) were not mentioned in the interviews, but based on the comments of indirect personnel costs not being calculated, it is assumed that the environmental related research and development costs are not monitored either separately. Cost category 6) of less tangible costs were found to be included in current practices at some level, but more accuracy or more controlled way of calculating the costs or liabilities is recommended to case company, which will be further discussed in chapter 7.

6.2 EMA methods and comprehensive framework

Several different EMA methods were presented in the chapter 3.4, including life cycle assessment, input-output balance and environmental performance indicators (EPIs). Schaeltegger and Wagner (2005) noted that a clear trend is seen to move from cost accounting towards material flows accounting and environmental impact assessment, which are often measured through indicators. Some reasons for increased attention to EPIs are complexity and plentiness of different cost accounting tools and methods. It seems that case company prefers indicator type of methods, which suits well to describe how things are changing. The EMA information in case company is emphasized to use performance indicators. However, none of the indicators directly included monetary information related to physical flows, so it might be worth of investigate the needs and possibilities to introduce such eco-efficiency indicators.

Furthermore, Lang et al. (2005: 147) discovered some overlap in different methods, but also some specific benefits for certain methods. Therefore, it is ideal to combine 2 or 3 methods to complement each other, in order to have different aspects of environmental information covered. Schaltegger and Wagner (2005) also noted, that company's interests as well as current and future needs play an important role when designing an EMA implementation. As inferred from above, my suggestion for case company is to search for the possibilities to introduce some other EMA method in order to broaden the viewpoints.

As variety of physical flow information is gathered already, additional effort to conduct input-output balance type of analysis of absolute material flows might be light. According to Lang et al. (2005: 147), input-output balance may provide sufficient benefits for environmental management when performed in two or three years' cycles or only when necessary as one-off performance. Input-output balance might be a good companion for other EMA instruments that provide more detailed information for shorter time periods, such as EPIs. However, more investigation of possible benefits of input-output balance to the case company is required before the implementation is considered reasonable. Whether such type of material balance analysis is not perceived to bring much added value to the company, alternatively the attention could be pointed to other methods such as full cost accounting or life cycle analysis or just developing the indicators towards eco-efficiency indicators.

To continue, life cycle assessment (LCA) as a method seems to be in its early steps in the case company. Despite of the challenges in producing information of full life cycle, it will probably be interesting to cover some parts of the assessment and also test it with some products as planned. Assumedly, these trials will give the case company new sort of environmental information, which will eventually guide the company further in it's environmental accounting activities. Therefore, my interpretation is that the LCA will be one important part of development areas in the field of EMA activities.

According to Burritt et al. (2002), a comprehensive framework for EMA, which was presented earlier in chapter 3.5 and Appendix 1, provides suggestions of tools for EMA in relevant situation and information need. They state that EMA is needed to "identify, measure, analyse and interpret information about environmental aspects in company activities". They also find important to note that different managerial levels and departments need different kind of information of environmental issues. Main advantages in comprehensive framework of EMA are said to be the classification of measures, mapping of EMA tools and bringing short-term or long-term perspective into consideration.

Derived from Burritt et al. (2002: 47), it is good to note, that different types of functions desire different information. Environmental function, for example, may prefer especially physical measures of material and energy flows and their impacts upon the environment, where as production management might be similarly interested of physical flow measures, but mainly in short-term focus which influence in production scheduling. On the contrary, the interest of accounting and finance department should merely be in monetary measures delivering information to short and long-term investment, financial KPIs, balance sheet related issues, risk assessments, investment decisions etc. (Burritt et al. 2002: 47.) In the case company, the people responsible for reporting are mostly employees from production operations, and the reporting is addressing the physical material flows measured by absolute and relative indicators. In the scenarios where monetary environmental information will possibly be integrated more tightly to environmental reporting, it is worthwhile to investigate the need to involve accounting's views in the financial related environmental topics mentioned above.

Harmonizing the reporting seems to be in the future plans of case company. Assumedly it is worthwile, as rapid changes in reporting framework may have caused overlapping and double reportings. Nevertheless, before just eliminating certain environmental

information related parts of reports or entire reports, it is recommended to carefully map current EMA tools and those organization levels or functions with specified information needs. As a consequence, reporting may be best to simplify from some areas, but similarly in other areas the reporting may be worthwile to even increase with deeper information.

Using the comprehensive framework of EMA, a view of the EMA activity areas that are covered in the case company already, is comprised next. It is interpreted, that boxes 2, 9, 13 and 14 (see Appendix 1) are already applied in the case company. In addition, some of the areas, such as 5 and 6, may be partly applied in the case company. The full analysis of the methods presented in the comprehensive framework would need more attention to case company's costing and management systems. Thus, it is satisfying in the limits of this study, to simply encourage the case company to further map the current environmental costing and management accounting methods, and reflect them to comprehensive framework. To clarify, it is not the idea to blindly target to implement all the EMA perspectives from the comprehensive framework, but to examine the individual needs of the company. It is encouraged to then implement those methods that fulfill the company needs and ambitions in the long run. Thus, this comprehensive framework can be utilized to case company to serve as an analytic tool when considering current and future EMA activities.

6.3 Challenges and new opportunities

Despite of many EMA benefits discussed earlier in chapter 3.7, many academic studies show low levels of EMA adoption (Christ & Burritt 2013: 164–165). Environment-related data may be difficult to collect and evaluate from conventional management accounting systems. It was detected, that the most visible challenge in the case company regarding EMA, was manual work in collecting data, which exposed the data to human errors. Typical challenges in EMA use according to IFAC (2005: 26) are underdeveloped communication between accounting and other departments; environment-related costs are hidden in overhead accounts; materials use, flow and cost information is not tracked adequately; many types of environment-related cost information are not found in the accounting records; investment decisions are often made on the basis of incomplete information. In addition, Burritt (2004: 15) discovered also challenges such as environmental costs not being assumed to be significant and performance measurement having too narrow and short-term focus. Of these, indirect

costs being hidden to overhead accounts and challenges in investment decisions were mentioned in interviews in relation to challenges encountered by the case company. Despite many of the challenges mentioned in literature were not detected or inferred from the case company's situation, they are good to be identified before entering to new EMA development projects.

Simlarly, the following success factors of EMA implementation, presented by Kumpulainen and Pohjola (2008: 489) are good to bear in mind, when planning possible next steps in EMA development: innovative attitude and motivated key personnel, transparent internal/external goal setting, a gradual EMA development, human resources and management support, involvement of personnel, value-chain thinking and benchmarking.

As presented in relation to research findings, some potential development areas were chosen, based on the inconcistency of interviewees' answers. Many of the suggested development areas are already parts of the current EMA practices, but there may be some inconsistency in certain procedures, which might call for more controlled way of handling the issues.

The first potential development area in the case company might be the improvement of environmental cost identification. As this activity is one fundamental thing in EMA activities, it would therefore be a good exercise to a case company, despite the fact that some areas of cost identification are at advanced level already. The case company could first ensure that all desired environment-related costs are identified according to a conscious decision what is desired to further analyze. Then, all the relevant employees and management team members should be ensured to be aware of which costs are relevant and how and why are these particular costs being identified and monitored.

The second potential development area in the case company might be the identification of less tangible costs, such as possible contingent liabilities. As stated earlier, despite the less tangible costs are difficult to quantify, they are seen important part of EMA (IFAC 2005: 49). Therefore, it is inferred that it might be beneficial for the case company to go through systematically the currently in-existing but in future possible environmental threats and try to quantify them. If some remarkable liabilities would appear, it might be relevant to discuss them with financial accounting department in order to assess whether they need to be taking account in financial statement as future liabilities.

Third potential development area might be cost account (re)structuring. As was mentioned in chapter 3.7, one of the challenges in EMA use was listed as “indirect environmental costs are lumped in with general business overheads” (Burritt 2004: 15). It is detected that case company does not separately account for indirect expenses of environmental function, so the costs are lumped in overhead accounts. If the case company desires to monitor environmental costs only at the current level (not indirect costs included), then the cost account structure might be sufficient in it’s current form, but otherwise it is recommended to go through the existing cost account structure and consider the alternatives.

The fourth potential development area might be involving environmental aspects more as a part of investment decision process. As IFAC (2005: 26) mentions, one of the EMA challenges is that investment decisions are based on incomplete information. It is interpreted, that the process varies in the case company, which calls for a more controlled process to include environmental aspets to investment decision process. It is assumed, that it would be relatively low effort to add some main principles or checklists to include in the investment process principles.

To summarize, the most visible challenge is manual work in gathering environmental data. Other less visible challenges, or rather threats, might be the inability to see the entire environmental cost scheme, the inability to detect possible future liabilities and the investment decision process being unable to capture the full scale of environemental aspects. All of the mentioned challenges or threats can be turned into future oppprtunities by investing especially attention and time resources to the development of environmental management accounting.

6.4 Environmental strategy adoption

Without being the main purpose of the study, few notions of environmental management in general can be stated. The model of environmental strategy adoption was presented earlier in chapter 2.3 with certain adoption stages (Epstein & Roy 2007: 394). Moreover, eco-control can be seen as a synonym for EMCS, which is the control system to ensure that the environmental strategy is executed across the functions and divisions of the firm (Guenther et al. 2016: 6). According to Henri and Journeault (2010: 64), eco-control is composed of three important practices: uses of performance

measures, budgeting and incentives. They reason, that eco-control directs managers to critical areas of concerns and eventually eco-control may lead to continuous improvements in environmental matters. (Henri & Journeault 2010.)

According to overall interpretation, the case company has accomplished all the mentioned steps of environmental strategy adoption stages, which were: (1) setting environmental objectives and targets for facilities, (2) certifying a facility to an international environmental standard (e.g. ISO 14001), (3) designing environmental programs, (4) allocating financial resources for environmental programs, (5) implementing systems to evaluate facilities' environmental performance. In addition, it can be inferred that environmental control system exist in the case company, enabling the measuring of the set environmental targets and thus ensuring the strategy is being excecuted.

Reaching the top stage is not surprising, as the company seem to be much devoted taking account environmental aspects in their business. Otherwise, a research of EMA practices might have been needless, if the case company wouldn't have indicated environmental integration strategy. As inferred from the interviews, employees feel privileged to work with such devotion to environmental issues. It is also seen that the company will continue to pursue sustainable actions, including the goal of further minimizing the environmental impact resulting from the company's operations.

7 DISCUSSION

This research has been motivated by the growing interest in sustainable business, which is evidenced for example in KPMG's (2015) report that shows increase in the voluntary corporate social responsibility (CSR) reports published globally. As a new EU directive will take effect in 2017, the reporting is not based on only voluntary reporting anymore.

It has been stated in the prior literature that connection between external and internal aspects of environmental reporting exists, and external environmental reporting may trigger a need for the development of internal EMA practices (Bouten & Hoozée 2013). EMA is an operational level system, which focuses on measuring, techniques and accounting instruments in the field of environmental matters in business. (Guenther et al. 2016: 6.) Interest in EMA has grown through the fact that environmental factors can have effect on the profitability and financial position of a business. (Bartolomeo & al. 2000: 35). Burritt et al. (2002: 41) have developed a classification of EMA, which divides environmental accounting to in terms of internal versus external target group as well as monetary vs. physical information dimension.

Only small, but growing part of studies has investigated current practices of EMA (Burritt, 2004; Ferreira et al., 2010; Christ & Burritt, 2013.) This research attempted to increase understanding of the practical side of EMA, including possible tools and instruments that are used, as well as reporting and analyzing. Prior literature of EMA existence in Finland is also hard to find, therefore, this research tried to fill the gap in national context. This research contributes to the existing EMA literature by exploiting the theoretical background of EMA methods and bringing them to the company level context in form of an overview of current EMA practices. Investigation of the encountered challenges in EMA practices as well as defining some future opportunities are additional aspects that assist in making in-depth analysis of EMA practices at the company level. As an outcome of this research process, a set of pragmatic recommendations to the case company was made (Appendix 4).

First it was presented literature on corporate social responsibility (CSR) in general and in Finnish context. The concepts of EMS including environmental strategy, EMCS and EMA were clarified and the dimensions of environmental accounting were illustrated in the Figure 2. Chapter 3 went deeper into the EMA itself, presenting the physical and monetary aspects of EMA as well as EMA methods and comprehensive framework of EMA. Also some practical examples were derived from earlier literature and possible

challenges and benefits of EMA were presented. Chapter 4 reasoned the methodological choices of the research, chapter 5 presented the key empirical findings and chapter 6 finally concluded the interpretations from results.

7.1 Research results

Results of this research are summarized next. The research targets were achieved and more detailed knowledge of EMA practices was gained, which increases the understanding of EMA utilized in the real life context.

Firstly, it was found out, that physical aspects of environmental accounting are more emphasized over monetary aspecs. Physical EMA is at advanced level, but monetary EMA is more fragmented, where operations related measuring is more utilized compared to more accounting centred measuring. *Secondly*, it was also discovered, that environmental performance indicators (EPIs) are mostly, and nearly solely, used systematical EMA tools in the case company. *Thirdly*, it was found out that a key challenge was found from the field of reporting, where the data collection is done mainly manually. Due to the existing several reporting levels, there is a relevant risk of human error and inconsistency in the figures.

Some practical recommendations were made to the case company, which are drawn together in the Appendix 4. Some of the recommendations are more simpler to apply, but some require careful consideration of effects of possible changes, and only then it can be said with more confidence, whether the action is recommended or not.

As a conclusion, the level of environmental related topics covered in the case company is quite advanced. Especially the production efficiency has been important dimension for the case company for some times already. The initial motivation for production efficiency might have been financial profitability, but it has also influenced by decreasing environmental strains. Despite advanced and even exemplary, pioneer environmental activities in general, there are also areas of development, which have not been paid attention so in detailed. In the case company's situation, possibly the controlled way of not only executing environmental improvements but also monitoring its effects in financial terms is one perspective to consider in future.

7.2 Research quality assessment

The case study as a method inquires proper documentation of the full research process. Here, the reliability has tried to be improved by explaining step by step the data collection process and the rationale for decisions behind the research methods used. The practicionist-researcher relationship was also discussed in chapter 4.4 of reliability and validity, and it is noted that the deeper background information of the case company might slightly affect to the interpretations made, but not any material level.

Regarding external validity of the research, the choice of single-case study approach restricts the generalizability of the results. However, as this research is more in-dept and qualitative nature, the generalization of the results is not the main purpose. As stated by Saunders et al. (2007), connecting the research properly to existing theory increases the significance of the study. In this research, analytic generalization has been reviewed by comparing the results to existing literature.

Construct validity is concerned of the used measures, thus related to data collection phase of the research. The used research methods (interviews, interviewer-administrated questionnaire and documentary analysis) are assessed reasonable in this particular case study setting and as used parallel they increase the construct validity. Also the questionnaire and the interviews form a chain of evidence, which also increases the construct validity. However, some restrictions to validity are noted in the amount and the nature of interviewees. At least one key informant was not included in the first stage interviews and the comments were only captured at high level. Also, the information given to interviewees before the actual interviews was minimal, which gave only limited possibilities to informants to prepare for the interview. In addition, more detailed presentation of the topic in general in the beginning of the interview sessions would have been preferable, but the topic was covered only at high level. Some weaknesses in the questionnaire setting might have caused due to insufficient explanations by the researcher. This might have caused some misunderstanding of the questions or themes during the interviews. Some limitations to validity was detected especially in question 2 regarding future liabilities, but the related assumptions to question 2 are presented in the relation to findings in chapter 5.

7.3 Limitations and future research prospects

As EMA was detected to be relatively little known as a term, it can be inferred that the systematical adoption of EMA principles is not conducted. This might create limitations to this research in terms of lacking common terminology and multiple interpretation layers, or phases between the researcher and the interviewees.

Possible future research prospects in the context of EMA in Finnish companies are more deeper conceptualisation of EMA and it's methods, and addressing why EMA has not succeeded in the implementations as academic literature would indicate. Furthermore, replicating of this study would also be future research prospect if the scope would made broader. The study might consist for example 2–3 companies and include comparison between their practices.

One relevant and major topic would also be to investigate more detailed the costing principles of environment-related matters. For example, as touched in this research, how indirect environmental costs are identified and controlled.

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APPENDIX 1: Comprehensive framework of EMA (modified from Burritt, Hahn & Schaltegger 2002: 43)

		Environmental Management Accounting (EMA)			
		Monetary environmental management accounting (MEMA)		Physical environmental management accounting (PEMA)	
		Short Term Focus	Long Term Focus	Short Term Focus	Long Term Focus
Past oriented	Routinely generated information	1. Environmental cost accounting (e.g. variable costing, and activity based costing)	2. Environmentally induced capital expenditure and revenues	9. Material and energy flow accounting (short term impacts on the environment - product, site, division and company levels)	10. Environmental (or natural) capital impact accounting
	Ad hoc information	3. Ex post assesment of relevant environmental costing decisions	4. Environmental life cycle (and target) costing Post investment assessment of individual projects	11. Ex post assessment of short term environmental impacts (e.g. of a site product)	12. Life cycle inventories Post investment assessment of physical environmental investment appraisal
Future oriented	Routinely generated information	5. Monetary environmental operational budgeting (flows) Monetary environmental capital budgeting (stocks)	6. Environmental long term financial planning	13. Physical environmental budgeting (flows and stocks) (e.g. Material and energy flow activity based costing	14. Long term physical environmental planning
	Ad hoc information	7. Relevant environmental costing (e.g. Special orders, product mix with capacity constraint)	8. Monetary environmental project investment appraisal Environmental life cycle budgeting and target pricing	15. Relevant environmental impacts (e.g. Given short run constraints on activities)	16. Physical environmental investment appraisal Life cycle analysis of specific project

APPENDIX 2: Interview guide

The purpose of this interview is my master's thesis research of ENVIRONMENTAL MANAGEMENT ACCOUNTING (EMA) – A case study of current practices in a Finnish manufacturing company.

One definition for EMA is: *"the generation, analysis and use of financial and related non-financial information in order to integrate corporate environmental and economic policies, and build sustainable business"* (Bartolomeo, Bennet, Bouma, Heydkamp, James & Wolters 2000)

Due to the specific and narrow subject of the research, only few interviews are conducted. Therefore Your participation is very important and highly appreciated. The interview will be held in Finnish and it will be recorded to help the later analysis.

Interview is based on relevant *themes*, which means that the actual questions and the order of the questions may vary in each interview session. Other themes may be included or excluded depending Your position in the company.

At least following themes are desired to cover in each interview session:

- The concept of EMA
- Environmental information *identification and collecing* in your company
    - Physical information (e.g. water consumption)
    - Monetary information (e.g. investment in capital projects that improve the environment)
- Environmental information *reporting and analyzing* in your company
    - If possible, an example of real report would be helpful
- Possible Environmental management accounting *methods or tools* used in your company
- Environmental information in softwares
- Environmental information needs (in Your position)
- Challenges in environmental information collecting/reporting
- Any other issues that You consider relevant in the subject of EMA

I would like to assure you that all responses are anonymous and all information that you give will be treated in confidence. Your identity/ your company's identity will not be connected to your answers in any way.

Thank you for your co-operation!

APPENDIX 3: Interview question layout (in stage 1 interviews)

- Can you describe your work responsibilities?
- Describe what kind on environmental accounting tasks involve to your work?
- How much time do you use to these tasks?
- Are you familiar with the term EMA, "environmental management accounting"?
- Next I will present certain EMA activities which might be applicable. Please assess, how they are implemented in your company
  1= Not in use , 2= somewhat in use, or planned, 3= is in use, 4 = I don't know

  (1) Identification of environment-related costs.
  (2) Estimation of environment-related contingent liabilities.
  (3) Classification of environment-related costs.
  (4) Allocation of environment-related costs to production processes.
  (5) Allocation of environment-related costs to products.
  (6) Introduction or improvement to environment-related cost management.
  (7) Creation and use of environment-related cost accounts.
  (8) Development and use of environment-related key performance indicators (KPIs).
  (9) Product life cycle cost assessments.
  (10) Product impact analyses.
  (11) Absolute water/electricity usage per products
  (12) Budgeting of environment-related costs
  (13) Assessment of potential environmental impacts associated with capital investment decisions.
  (14) Budgeting of waste, water consumption etc
  (15) Monitoring the material flow from recycled wastes
  (16) Monitoring losses from production (scrap)

- How environmental data exists in the softwares (that you use)
- How environmental related data are monitored in your company? For example in management monthly reports?
- Do you have some systematic way of controlling environmental costs or other data?
- Who is responsible for collecting/reporting environmental data?
- Do you feel that you have enough env. data available, in order to fulfill your work duties?
- Is some data irrelevant or useless?
- What kind of challenges exists in collecting/reporting environmental information?
- Do you have anything else in mind, that relates to the topic?

APPENDIX 4: Summary of pragmatic recommendations to case company

Focus	Recommendation	References or explanation
Monetary EMA	(Re)-identify environment-related costs and consider if indirect cost should be included.	Environment-related costs are hidden in overhead accounts (Burritt 2004:15; IFAC 2005:26).
Monetary EMA	Estimate "less tangible costs", such as contingent liabilities and other "difficult-to-quantify" environmental matters. See examples of IFAC 2005: 49–52.	"Difficult to quantify" externalities are important to understand to avoid negative surprises (IFAC 2005: 49).
Monetary EMA	Update or work through the environment-related cost account structure in order to build concensus on cost monitoring.	Many types of environment-related cost information are not found in the accounting records (IFAC 2005: 26).
Monetary EMA	Add environmental impact assessment as a part of investment decision process	Investment decisions are often based on incomplete information (IFAC 2005: 26).
EMA methods	-Add more monetary aspects to performance indicators (eco-efficiency indicators) -Involve accounting department to the development process of monetary measures	-Combine economic and ecological information in ratio form (Schaltegger & Wagner 2005: 55). -Ensure the proper usage and concistency of monetary measures.
EMA methods	Add some EMA method to be used together with EPIs	The combination of 2 or more methods is essential due to different emphasis (Lang, Heubach & Loew 2005).
EMA methods and reporting	- Use "comprehensive framework of EMA" as an analytic tool to assess current methods and future opportunities in EMA - Map 1) currently used EMA tools and 2) functions with specified information needs → compare to harmonizing needs of env. reporting.	Comprehensive framework provides suggestion of tools for EMA in relevant situation and information need (Burritt, Hahn & Schaltegger 2002).
EMA reporting	Consider implementing automation in environmental data collection	Manual work increases the risks of human error and inconsistency of figures (Interview data)